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National Urban Pesticide Applicator Survey
Final Report. Technical Volume 1
Survey Design and Implementation

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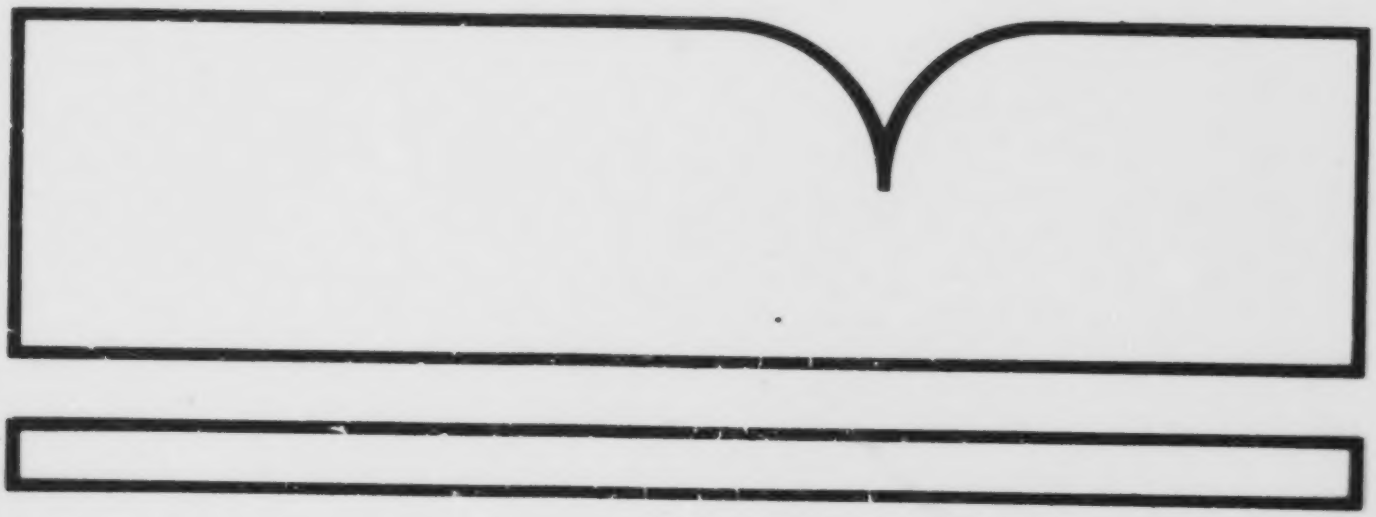

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NATIONAL URBAN PESTICIDE APPLICATOR SURVEY: FINAL REPORT

Technical Volume I: Survey Design and Implementation

by

Richard D. Waddell
Frederick W. Immerman
Douglas J. Drummond
Mary Beebe Woodside

Research Triangle Institute
Research Triangle Park, NC 27709

Contract No. 68-01-6646

Task Manger: Linda Zarow
Project Officer: Edward Brandt

Economic Analysis Branch
Benefits and Use Division
Office of Pesticide Programs
U.S. Environmental Protection Agency
401 M. Street, SW
Washington, DC 20460

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16. Abstract (Limit: 200 words)

A study has just been completed of pesticide usage in three sectors of the commercial pest control industry-tree, lawn and structural. This study was funded by the EPA and was jointly sponsored by the three trade associations representing these sectors and the Association of American Pesticide Control Officials.

A total of 2,838 firms in the industry responded to the survey by providing data for the year 1981. They represented all regions of the country, and all firm sizes. The sample included firms belonging to the cooperating trade associations and other firms as well.

About one out of every three eligible businesses from individual state licensing lists was included in the sample. All states except North Dakota and Alaska participated. Sample selection was in accordance with a probability-based design permitting valid statistical inferences for each industry sector and geographical region.

Respondent eligibility criteria are indicative of the scope of the survey. A business was eligible if it--1) was on a state licensing list, 2) was in' business in 1981, 3) provided commercial pest control services, and 4) did not provide strictly agricultural pest control services.

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Edward Brandt, Economist, Economic Analysis Branch
Peter Kuch, Supervisory Economist, Economic Analysis Branch
Linda Zarow, Economist, Economic Analysis Branch

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Robert Felix, Executive Vice President

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Richard Carr, Director of Research
Jack Grimes, Director, Government Affairs
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1. INTRODUCTION AND BACKGROUND

1.1 Overview and Introduction

The National Urban Pesticide Applicator Survey (NUPAS) was designed to obtain quantitative data regarding the nonfarm pest control industry and nonfarm pesticide use with the goal of making statistically valid estimates at the national, regional, and state levels of aggregation. These data are vitally important for the risk/benefit analyses and regulator impact analyses that affect the industries represented by the participating trade associations--namely, the National Arborist Association (NAA), the National Pest Control Association (NPCA), the Professional Lawn Care Association of America (PLCAA), and the Association of American Pesticide Control Officials (AAPCO).

The intended target population for the NUPAS survey was all commercial, nonagricultural tree, lawn, and structural pest control firms in the United States. All states and the District of Columbia were contacted and asked to furnish lists of such firms and all states except North Dakota and Alaska agreed to cooperate.

Data collection for NUPAS was primarily by mailed questionnaire with telephone and mail follow-up. Extensive plans were made to encourage firms to respond . Since most sample firms were small and the respondents had to set aside time from their business activities to answer the questions, a low initial response rate was anticipated. Throughout the data collection period, a media campaign was conducted to encourage participation; this campaign included ads in trade journals, announcements at professional meetings, and other means. The survey methodology included various follow-up procedures, namely mailings to survey nonrespondents of Thank You/

Reminder postcards, second questionnaires, and special letters printed on individual state AAPCO official's letterhead. In addition, all sample members who had not responded by a certain date were prompted by telephone. Following the telephone prompting, personal visits were made to a sample of nonrespondents to encourage response.

At EPA's request, the Research Triangle Institute (RTI) became involved in NUPAS to (1) design the survey questionnaire, (2) design and select the sample, (3) collect the data, (4) reduce the data to machine-readable form, and (5) analyze the data. However, RTI's involvement began after considerable preparatory work had already taken place at EPA.

This volume of the NUPAS report describes survey activities from the point of EPA's early discussions with the professional associations through the conduct of follow-up activities. This volume is supported by appendices, and reference will be made, when appropriate, to earlier documents submitted to EPA. The survey activities are presented in two ways. First, the general approach is described, and second, the activities and decisions which ultimately affected the quality of the data are discussed.

1.2 Preliminary Survey Activities

EPA personnel and representatives of professional trade associations did a great deal of work before RTI became involved in the NUPAS project.[1] These preliminary survey activities are discussed in the following sections.

1.2.1 Requests from States to Conduct NUPAS

Prior to 1981, the Department of Agriculture was responsible for many of the surveys on pesticide use which were centered in the rural/farm

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[1]The Acknowledgements page lists the major NUPAS contributors from EPA, the trade associations, and RTI. These persons were involved in the activities discussed in this volume.

sectors where many of the pesticides were used. As a result, EPA lacked accurate quantitative data on pesticides applied by professional applicators in the urban/nonfarm sectors of the nation. In addition to serving as inputs for pesticide regulatory and research programs, these data help states to assess the effectiveness of local programs, and determine potential risks to the local environment (water, air, etc.). Voicing these concerns, several state officials contacted the Agency and asked about the possibility of securing funding to conduct a urban pesticide study.

Likewise, several professional trade association expressed an interest in such a survey effort since representatives from various states had spoken to association officials concerning the need for more data related to the urban/nonfarm sector.

1.2.2 EPA and the Trade Associations

As a first step in addressing the need for quantitative pesticide usage data, EPA established a committee composed of the representatives of the National Arborist Association (NAA), the Professional Lawn Care Association of America (PLCAA), the National Pest Control Association (NPCA) and the Association of American Pesticide Control Officials (AAPCO). Among other things, this committee developed industry-specific questionnaires for use in a mail survey.[2] This group also publicized the survey with state regulatory authorities and professional applicators to encourage their participation.

Committee members were responsible for peer review and comment on any draft reports prepared by EPA or other organizations associated with the

[2]Copies of these and other documents related to the NUPAS may be found in RTI Report # RTI/2764/08--01S, "National Urban Pesticide Applicator Survey (NUPAS) Supporting Documents".

survey. Because this was to be a cooperative effort, EPA agreed to furnish the associations with copies of the survey results as well as deliver to the NPCA representative a data tape to be shared with the other cooperators.

As a second planning step, NPCA contacted AAPCO to assess the availability of listings for registered commercial pesticide control operators in each state. Both EPA and NPCA thought that such listings would provide an efficient sampling frame for the intended survey.

This cooperative effort between EPA and the associations was felt to be an extremely positive feature of the NUPAS joint venture. By involving the associations from the onset of planning through data collection, project staff anticipated a high response rate, extensive publicity, and strong cooperation by association members. The active support of the associations was deemed essential to the success of the survey, especially since this sample population had never been involved in such a data collection effort prior to NUPAS.

1.2.3 American Association of Retired Persons (AARP) Telephone Survey

The EPA has an existing cooperative agreement with the American Association of Retired Persons (AARP) under which task order activities in support of the Pesticide Usage Projects can be conducted. In March 1981, EPA issued a task order for AARP to conduct a telephone survey to gather the following information from each state: the number of certified private applicators; the number of certified commercial applicators by category; the number of businesses employing the commerical applicators; and the method of listing the names and addresses of the applicators and businesses. Also, in support of the termiticide portion of the pesticide studies project, EPA requested information on the number of structural pest control

applicators and firms engaged in termite control, the number of structures treated each year, and the amount of selected pesticides used per year.[3]

While this activity was not conducted specifically for NUPAS, the information on the number of certified applicators in the commercial sector was helpful in preliminary planning efforts for the survey. The information was extremely valuable in forming preliminary estimates of the total sample universe within the pesticide applicator certification categories of interest for NUPAS, i.e., federal categories 3 and/or 7.

1.3 Advance Survey Planning with Trade Associations

The Office of Pesticide Programs staff had numerous planning meetings with other offices within EPA (representatives from Information Management staff, Office of Toxic Substances, Pesticide and Toxics Enforcement, etc.) and with representatives from the trade associations who comprised the NUPAS Planning Committee. During these meetings, which preceded RTI's involvement with NUPAS, many decisions regarding the survey methodology, handling of materials, and schedule of survey events were made. These and other advance planning activities are discussed in the following sections.

1.3.1 Trade Association Draft Questionnaire

EPA requested that each trade association representative to the NUPAS Planning Committee submit a draft questionnaire (or at minimum, a list of data objectives) that would capture the data needs for his/her respective organization. Also, EPA enlisted the services of a consultant and an agency statistician to independently review the draft questionnaires to ensure that the information requested was useful to both the industry and EPA.

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[3]See RTI Report #RTI/2764/08-01S for a copy of the AARP survey documentation.

The draft questionnaires contained questions related to quantitative measures such as the number of firms by state, the number of personnel employed by the firms, and the percentage of expenses for various personnel levels; descriptive information dealt with pest management practices by major site categories (i.e., household, commercial food handling, industrial and institution, etc.) and further requested the following information by site: number of structures inspected/treated, pests treated, pesticides used and total amounts, formulations, application frequency, method of application, etc.

1.3.2 Preliminary Schedule

Part of EPA's and the trade associations' preliminary planning included the development of a schedule of primary activities. While helpful for planning purposes, this schedule (see Figure 1-1) was substantially departed from in the survey. The primary motivation for refinement of the schedule was the realization that data collection would be adversely affected if it occurred during the busy season (i.e. spring through early fall) of the lawn and tree pest control operators (PCO's). A decision was therefore made to attempt to collect data prior to the beginning of the busy season. This significant shortening of the schedule was expedited by the fact that since the cooperating states requested that RTI conduct NUPAS, EPA could be viewed as a nonsponser, and therefore OMB clearance was not required. The revised schedule was recognized as ambitious, especially for developmental activities, and that slippages could occur. The final realized schedule for Volume I activities is presented in Table 4-1.

1.3.3 Advance Survey Publicity

As part of their commitment to NUPAS and to encourage participation, the cooperating trade associations agreed to publicize the survey with

I. Analysis Phase and Questionnaire Development

Activities	Schedule
1. Initial interphase of committee members	3/16/81
2. Draft "Need Survey" prepared to form basis of analysis plan	4/15/81
3. Advisory Group Meeting	4/23/81
4. Committee member meeting	5/1/81
5. Committee comments on Needs Survey submitted to EPA	5/15/81
6. Advisory Group comments on Needs Survey	5/15/81
7. Draft analysis plan prepared by EPA	12/15/81
8. Comments received on analyis plan by committee and advisory group	12/31/81
9. Finalization of questionnaire	12/1/81
10. Review by Inter-Agency Planning Group	12/31/81
11. Finalization by contractor	2/15/81
12. Pre-test of questionnaire completed	3/30/82
13. Analysis plan and questionnaire submitted to OMB	5/16/82
14. Launch survey	9/1/82

II. Development of Frames and Sampling Strategy

Activities	Schedule
1. AAPCO obtain from state lead agencies, available lists	12/31/81
2. Integrate lists and design a sampling strategy	4/5/82
3. Final sampling strategy submitted to PMB	5/16/82
4. Sample selection	6/30/82

III. Development of a Complete Plan and Product to Implement Survey

IV. OMB Clearance Process

Work Items	Schedule
1. OMB package prepared	5/16/82
2. OMB approval	8/16/82

V. Launch Survey 9/1/82

VI. Data Processing and Analysis of Results 10/1/82

Figure 1-1. Preliminary Schedule

state regulatory authorities and professional applicators. In addition, AAPCO took the added responsibility for coordinating actions with state regulatory agencies.

Association Committee representatives presented information about NUPAS at association meetings and functions and conducted what was described as an extensive media campaign with the industry. Advertisements were run in trade journals, letters were sent to heads of state association affiliates, telephone calls were made to persons who might encourage participation, and contact was made with state pesticide regulatory officals.

From the onset of NUPAS planning, the trade association representatives informed EPA and later, RTI, that there should be few problems with securing sample firm's cooperation. However, RTI felt there were several factors that might affect the response rate, two of which were considered significant--(1) the NUPAS design called for a mail survey (see following section) when the questionnaire was not easily adaptable to such a design, and the information requested would probably have been better acquired by personal interview; and (2) the industry had not previously been surveyed so little was actually known as to how individuals would accept the effort, understand its importance, and take the time required to complete the questionnaire.[4]

1.3.4 Use of Mail Survey Methodology

During their meetings, EPA and the Planning Committee, discussed the most appropriate way to conduct the survey. After considering possible methodologies, the Committee felt that a mail survey would place the least

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[4]Although an earlier survey conducted in the state of Florida included a subsample of PCO's, a survey of NUPAS's magnitude had not previously been conducted.

burden on the respondents. Also, the anticipated economies of a mail survey were more attractive than the expense of personal interviews. Most likely, an interviewer would not be able to complete the questionnaire on the first visit due to time constraints and the record searches necessary to furnish the information. Therefore, EPA and the Committee felt that a mail survey was the most appropriate methodology for NUPAS. This decision was stated in the wording of the RTI task order and discussed at initial planning meetings.

1.3.5 Use of State Lists of Registered Commercial Operators

State regulatory lists were cited as being the most complete and accurate available sources of information on the intended target population, and were therefore chosen to serve as the basis for NUPAS frame construction. AAPCO mailed letters to all states and the District of Columbia requesting that they furnish lists of applicators certified in federal categories 3 and/or 7 to apply pesticides in their states. Estimates of the number of certified applicators for each industry, based on preliminary findings from the AARP survey, were: Arborists -- 12,000; Lawn Care -- 7,000; and PCO's -- 20,000.

The Committee felt that these regulatory lists would be "clean" (i.e., firms would be listed only once and not represented in several categories, etc.) and complete (i.e., probable data elements would include name of firm, business license number, address, telephone number, etc.). RTI recognized from the outset that no organized effort to use state licensing lists as a sampling frame had ever been attempted. Moreover, little was known as to how states chose to carry out their licensing arrangements. It was expected that the Committee would take a leading role in establishing the priorities of the sample design.

1.3.6 Use of Oakton, Virginia Facilities

NPCA offered to secure a post office box for receipt of completed questionnaires. It was felt that the use of an affiliated association address might persuade firms to respond. To this point, survey stationery (see following section) was designed with this address shown.

Two problems associated with the use of this facility surfaced once the data collection began:

(1) Some firms (certainily a few were NPCA members) chose to return their completed forms to this address rather than use the RTI postage-paid envelope enclosed with the questionnaire. NPCA officials had to collect these forms and send them to RTI causing delays in receipt and processing. Likewise, firm identification could have been possible if they used their own stationery for mailing but this was done knowingly. EPA was never given access to firm identification materials.

(2) There were inefficiencies and processing delays associated with handling undeliverable questionnaires since these were returned to the Virginia location by the post office.

1.3.7 Development of Survey Materials

As mentioned above, some survey materials were developed by EPA and the Committee during the planning phase of NUPAS. Primarily, these included the letterhead[5] and envelope design for the questionnaire mailings and returns. In fact, these were printed in bulk by the time RTI became involved in the survey. Drafts of letters to accompany the questionnaire had been prepared as well as publicity statements to be used by the trade associations.

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[5]See RTI Report # RTI/2764/08-01S.

2. SAMPLE DESIGN

2.1 Desired Target Population

During the preliminary stages of planning for NUPAS, the target population was defined to be all firms operating in the United States in 1981 that offered commercial pest control services in one of the three qualifying industry sector (lawn and turf; tree, shrub, and ornamental; and structural pest control). Firms that worked only in commercial agriculture or on golf courses were specifically excluded from the target population because both of these sectors had been covered in previous surveys of pesticide usage.

The decision to develop the NUPAS sampling frame from state regulatory lists (see section 1.3) led to a modification in the definition of the NUPAS target population. Instead of covering all commercial pest control firms associated with the three industry sectors, the modified target population included only those firms and/or pest control operators that were regulated in the cooperating states. The modified definition is thought to represent a significant proportion of all commercial, non-agricultural pest control firms. Participation, either voluntary or mandatory, by pest control firms in state regulatory programs is believed to be relatively high, and the two states which declined to participate in NUPAS (Alaska and North Dakota) are served by only a small number of non-agricultural pest control firms.

2.2 Frame Construction

2.2.1 Characteristics of State Regulatory Lists

Each state that agreed to cooperate in NUPAS was asked to provide a list of certified pest control operators or firms that were regulated by

the state in 1981; the list was to include only those members in EPA pest control categories 3A (tree, shrub, and ornamental), 3B (lawn and turf), or 7 (structural). These lists, which were provided to RTI in January and February of 1982 varied in content and format -- a fact that was not anticipated during the planning stages of NUPAS. The State lists varied in the following ways:

- the level of the list elements (i.e., individual applicator vs. branch office vs. firm headquarters)
- the designation and specificity of the industry categorizations
- the physical form of the list (i.e., computer printout, book, letter, or mailing labels)
- the amount of auxiliary information (e.g., telephone numbers, business license number, etc.).

Variation among the lists reflects the diversity of state efforts to regulate the pest control industry within the broad guidelines of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Characteristics of the lists are profiled in Table 2-1.

The construction and utilization of an adequate sampling frame required that the lists be standardized to the extent possible. Some basic structural differences in the lists could not be overcome directly, and these were accommodated by modifying the original sample design. The lack of uniformity among the lists necessitated the expenditure of considerable resources, and affected many subsequent NUPAS activities.

2.2.2 Industry Sector Categorization

To ensure adequate, balanced representation for each sector of the pest control industry in each geographic region of the country, NUPAS used stratified sampling, with strata defined by state and industry sector. Therefore, each element on the state li[illegible] had to be classified by industry sector. This was originally envisioned to be a straightforward task, using

Table 2-1. Nature of Licensing Lists by States

State Name	Licensed Category[1]	Unit Licensed Firm[2]	Unit Licensed Individual[3]	Correspondence of Licensed Category[4]	Form of List[5]	Entries on Frame Original	Entries on Frame Cleaned	Source of List
Alabama	3	√[6]		2	2	880	532	St. Dept. of Agric.-Plant Div.
	7	√[6]		2	2			
Arizona	3		√[3]	1	2	1200	-[3]	St. Dept.-Pest. Control Bd.
	7		√[3]	1	2			
Arkansas	3		√	2	2	520	266	St. Dept. of Commerce-Plant Div.
	7		√	2	2			
California	3	√[2]		3	1,2	2300	2170	St. Dept. of Food & Agric.
	7	√[2]		3	1,2			
Colorado	3	√		2	2	312	264	State Dept. of Agric.
	7	√		2	2			
Connecticut	3		√	2	1	1100	836	State Dept. of Envir. Protection
	7		√	2	1			
Delaware	3	√		2	2	168	132	State Dept. of Agric.-Production & Promotion
	7	√		2	2			
District of Columbia	3	√[6]		1	2	195	142	Council of D.C.
	7	√[6]		1	2			
Florida	3	√[2]		3	2	1298	1254	Dept. of Health & Rehabilitative Services
	7	√[2]		3	2			
Georgia	3	√[6]		1	1,2	1000	669	State Dept. of Agric.
	7	√[6]		1	1,2			
Hawaii	3		√	1	1,2	250	191	State Dept. of Agric.
	7		√	1	1,2			

Table 2-1. Nature of Licensing Lists by States (cont.)

State Name	Licensed Category[1]	Unit Licensed Firm[2]	Unit Licensed Individual[3]	Correspondence of Licensed Category[4]	Form of List[5]	Entries on Frame Original	Entries on Frame Cleaned	Source of List
Idaho	3		√	2	3	406	91	State Dept. of Agric.-Plant Div.
	7		√	2	3			
Illinois	3	√[6]		1	1	1300	1167	Dept. of Public Health
	7	√[6]		1	1			
Indiana	3	√[6]		1	4	706	695	State Chemical & Seed Commission
	7	√[6]		1	4			
Iowa	3	√[6]		1	1	1170	371	State Dept. of Agric.-Pesticide Div.
	7	√[6]		1	1			
Kansas	3	√[6]		1	3	825	449	State Bd. of Agric.-Pesticide Div.
	7	√[6]		1	3			
Kentucky	3		√	1	2	440	405	Sent thru Grimes' office/no cover letter
	7		√	1	2			
Louisiana	3		√[3]	3	1	780	-[3]	State Dept. of Agric.
	7		√	3	2			
Maine	3	√[2]		3	2	115	85	State Dept. of Agric. Food & Rural Sources
	7	√[2]		3	2			
Maryland	3	√[6]		2	3	576	459	State Dept. of Agric.
	7	√[6]		2	3			
Michigan	3	√[2]		3	2,3	1776	845	Dept. of Agric.-Plant Industry
	7	√[2]		3	2,3			
Minnesota	3		√	1	1	2900	239	State Dept. of Agric.-Dept. of Agronomy
	7		√	1	1			

Table 2-1. Nature of Licensing Lists by States (cont.)

State Name	Licensed Category[1]	Unit Licensed Firm[2]	Unit Licensed Individual[3]	Correspondence of Licensed Category[4]	Form of List[5]	Entries on Frame Original	Entries on Frame Cleaned	Source of List
Mississippi	3	√		2	2	336	309	Dept. of Agric.-Plant Div.
	7	√		2	2			
Massachusetts	3		√[3]	3	1	4900	-[3]	Dept. of Agric.
	7		√[3]	3	1			
Missouri	3		√	1	1	1296	1058	State Dept. of Agric.-Pesticide Control
	7		√	1	1			
Montana	3		√	2	1	215	100	Dept. of Agric.-Environ. Mngt. Div.
	7		√	2	1			
Nebraska	3		√[3]	3	1	644	-[3]	Air and Waste Compliance Bd.
	7		√[3]	3	1			
Nevada	3	√[2]		3	2	108	78	State Dept. of Agric.
	7	√[2]		3	2			
New Hampshire	3	√[6]		2	2	220	94	State Dept. of Agric.-Pest Control Div.
	7	√[6]		2	2			
New Mexico	3		√	1	1	200	170	State Dept. of Agric.
	7		√	1	1			
New York	3	√[6]		2	1	5561	1795	N.Y. Dept. of Environmental Conserv.
	7	√[6]		2	1			
New Jersey	3	√[6]		2	1	1417	1218	Dept. of EPA-N.J.
	7	√[6]		2	1			
North Carolina	3		√	3	1	3372	720	Dept. of Agric.-Pesticide Div.
	7		√	3	1			

Table 2-1. Nature of Licensing Lists by States (cont.)

State Name	Licensed Category[1]	Unit Licensed: Firm[2]	Unit Licensed: Individual[3]	Correspondence of Licensed Category[4]	Form of List[5]	Entries on Frame: Original	Entries on Frame: Cleaned	Source of List
Ohio	3		√	3	3	3625	1251	State Dept. of Agric.
	7		√	3	3			
Oklahoma	3	√[6]		1	-	1350	727	State Dept. of Agric.-Plant Div.
	7	√[6]		1	2			
Oregon	3	√[6]		1	1	477	245	State Dept. of Agric.
	7	√[6]		1	1			
Pennsylvania	3		√[3]	3	1	2500	-[3]	State Dept. of Agric.
	7		√[3]	3	1			
Rhode Island	3		√	1	2	378	124	Div. Environmental Management
	7		√	1	2			
South Carolina	3		√	2	1	832	571	State Dept. of Agric.
	7		√	2	1			
South Dakota	3		√	2	2	630	84	State Dept. of Agric.
	7		√	2	2			
Tennessee	3	√[6]		1	3	484	336	Dept. of Agric.-Plant Div.
	7	√[6]		1	3			
Texas	3	√[6]		2	1	3600	2122	Dept. of Agric.
	7	√[6]		2	1			
Utah	3		√	2	2	104	98	Dept. of Agric.
	7		√	2	2			
Vermont	3		√	1	2	168	72	Dept. of Agric.
	7		√	1	2			

Table 2-1. Nature of Licensing Lists by States (cont.)

State Name	Licensed Category[1]	Unit Licensed Firm[2]	Unit Licensed Individual[3]	Correspondence of Licensed Category[4]	Form of List[5]	Entries on Frame Original	Entries on Frame Cleaned	Source of List
Virginia	3		√[3]	3	1	1507	-[3]	Dept. of Agric.-Consumer Div.
	7		√[3]	3	1			
Washington	3	√		2	2	196	180	Dept. of Agric.
	7	√		2	2			
West Virginia	3		√[3]	3	4	137	-[3]	Dept. of Agric.
	7		√[3]	3	4			
Wisconsin	3	√[6]		2	1	375	220	Dept. of Agric.-Trade & Consumer Div.
	7	√[6]		2	1			
Wyoming	3		√	3	2	50	47	Dept. of Agric.
	7		√	3	2			

[1] Tree/Lawn = Cat. 3
Structural = Cat. 7

[2] Indicates license numbers had to be obtained by field staff.

[3] Indicates firm name not given. A sample of individuals were contacted by telephone.

[4] Category Codes 1=same 2=some amount of interpretation 3=large amount of interpretation.

[5] Form of List 1=Printout 2=Letter 3=Book 4=Mailing labels.

[6] Firm license number was available for entire frame and was used to identify unique firms.

generalized sectors defined as outdoor pest control, (i.e., tree, shrub, ornamental, lawn, and turf) corresponding to EPA categories 3A and 3B, and indoor pest control (i.e., structural and general) corresponding to EPA category 7.

However, not all states use the EPA classification scheme, but have instead developed their own. Some of the state classifications are readily mappable to the EPA categories, while others require considerable interpretation to translate them into the indoor/outdoor sector categorization (see Table 2-1 for profiles of how much interpretation was required). One of the first tasks following receipt of the state lists, was to develop a procedure for mapping each state's classifications to the EPA categories. In some states, no sector classification information was provided. In these states all list members were assigned to the "unknown" sector category. Some states provided lists with elements that were outside the two sectors of interest in NUPAS (e.g. agricultural applicators were included). Whenever they could be identified as such these elements were removed from further consideration in the frame construction process.

States vary particularly in their methods of classifying particular specialities, such as commodity fumigation and right-of-way pest control. For example, some states classify commodity fumigators as agricultural, and either did not include them on the list provided to RTI, or included them in a category that was subsequently removed from consideration. In other states, commodity fumigators are put in a distinct category, which may or may not have been included in the list sent to RTI. Finally, some states include commodity fumigators in the structural category. This variation in classification resulted in uneven coverage of the specialities by the sampling frame. Detailed state-by-state assessments for the degree of undercoverage have not been done.

Following development of the procedure for mapping a state-specific classification to the EPA categories, all list elements were assigned to the appropriate sector. In those states which provided separate lists for each sector, any firm or PCO that appeared on both lists (and could be recognized as such) was reduced to a single list element and classified as belonging to both sectors.

2.2.3 Construction of the Firm-Level Frame

The primary goal of the NUPAS sample design was to select a sample of eligible pest control firms. Therefore, a firm-level sampling frame would ideally have been developed from the regulatory lists supplied by the states.

Variation among the state lists in terms of the level of the elements (i.e., individual vs. firm), in turn produced variation in the effort required to incorporate the list elements into the firm-level frame. For 24 states and the District of Columbia, frame development was relatively straightforward because the States provided lists of firms. For 17 other states which provided lists of applicators, there was also what appeared to be employer information on the lists which could be used to develop lists of firms operating in each of these states. While it did not adversely affect the schedule, this process was done by hand and required considerable labor resources. The size and complexity of the task and short period of time within which it had to be accomplished combined to increase the likelihood of clerical error during list development. All of these lists were then computer-coded to permit efficient cleaning and sample selection. The 41 states and D.C. will be referred to as "mail states" (because the first contact with the sample members in these states was by mail) for the remainder of this report.

The seven remaining states (Arizona, Louisiana, Massachusetts, Nebraska, Pennsylvania, Virginia, and West Virginia) provided lists of individual applicators with no information on employers, hence, it was not possible to develop a direct firm-level frame for these states. (One partial exception occurred in Louisiana, which supplied a firm-level list for one sector of the industry. This list was used to develop a firm-level frame for this sector.) Therefore, in these states it was decided to employ a two-stage sample design to ultimately select a firm-level sample. In the first stage, a sample of applicators was selected and screened to determine if they were employed by a pest control firm or firms. Because the screening in the first stage was done by telephone, these 7 states will hereafter be referred to as the "telephone states" in this report. Frame development for the telephone states will be discussed in Section 2.2.4.

For the mail states the next step in frame development was to remove duplicate listings of firms. Decisions made both during the planning stages of NUPAS and following receipt of the state regulatory lists guided this cleaning effort. Input from the EPA and the trade associations led to a decision to keep frame elements at a within-state level. That is, if a firm appeared on lists from several states, it was retained on each of those lists, and would be asked to provide state-specific usage data only for those states in which it was sampled. It was assumed that firms would not have difficulty reporting at this level, and obtaining state-level data would make it easier to generate a state-specific usage estimates. State-level reporting also increased the level of confidentiality for respondents. The variation between the state regulatory lists in structure, completeness, and auxiliary information strengthened the case for state-level frame elements, since across-state matching would have been a resource-intensive task with a limited effectiveness given the variability among lists.

Within a mail state, duplicates were defined as elements that matched either in business license number or in firm name within a five digit zip code. Similarity of zip code rather than exact address was used because address information did not follow a standardized format (e.g., street addresses were reported in some records, while in others addresses were given as post office boxes) and inconsistencies were apparent in address reporting (e.g. elements with the same firm name and same street name but different number, or same number but different street name). Elements with the same or similar firm names that had different zip codes were retained. In some states, the intended level of cleaning may not have been realized because the addresses reported on the lists could have been home, rather than business addresses of the applicators.

No attempt was made to clean to a unique occurrence of a firm name within a state for the following reasons:

- The lists lacked the information on the business status and relationships among lists elements (e.g. which elements were headquarters, which were branch offices of the same company, which were franchises, etc.) necessary for identification of the principal location of the company in the state.
- Even if a principal location could have been designated, it was assumed that in at least some cases the location would not be able to provide the desired information on pesticide usage by all company locations in that state.
- Because it is possible for distinct businesses to have the same name, structural nonresponse could have been introduced by cleaning to a single entry of a firm name. Structural nonresponse is more difficult to compensate for than multiplicity.

Instead, the questionnaire allowed respondents to define the within-state entity that they could report on, and post-selection mechanisms were used to correctly weight and analyze the data (see Technical Volume II, Chapter 4).

The effectiveness of the data cleaning process within a state depended on the nature and quality of the auxiliary information on the regulatory lists. Cleaning based on business license number was not possible in the 26 states that did not use or report business license numbers. In the remaining mail states, several known cases of structural undercoverage were introduced when business license numbers were incorrectly reported on the lists. The matching, based on firm name and zip code, likewise, depended upon the accuracy of the information on the list. Improper designation of zip codes and variations in firm names led to retention of elements that should have been defined as duplicates and removed.

The number of elements on each state's regulatory list(s) and on the resulting computerized frame are given in Table 2-1.

2.2.4 Frame Construction in Telephone States

A detailed account of the frame construction processes for both stages of sampling in the seven telephone states is given in Appendix A. Points of primary importance are:

- Schedule considerations did not permit construction of computerized frames.
- The first-stage sample was selected using the regulatory lists cleaned of obvious ineligibles (i.e. elements in industry sector categories not covered by NUPAS) and within-state duplicates (i.e. same applicator name and address).
- Contacting some first-stage sample members was difficult due to inaccuracies and inconsistencies in telephone numbers and addresses on the regulatory lists. Telephone numbers were not reported for some sample members.
- Second-stage frame construction was based on information provided by first-stage respondents who indicated that they worked for a firm or firms eligible for inclusion in NUPAS. Respondent error in assessment of eligibility may have affected the coverage of the intended population and any inaccuracy in firm names and/or addresses may have negatively affected the ability to contact or locate referenced firms.

2.3 Sample Design

2.3.1 Sample Design in Mail States

In an effort to ensure adequate representation for each of the industry sectors and states covered by NUPAS, a stratified sample design was used to select the sample in the mail states. The mail state frame was stratified into 123 strata by industry sector within a state. In some states, sectors had to be collapsed to achieve an adequate stratum size. Sample sizes for the strata were allocated with a goal of achieving, to the degree possible, an equal weighting sample by industry sector. The following constraints were imposed to guarantee minimum levels of precision and to provide a measure of control over the variability of the sampling weights:

- Minimum (if possible) of 5 sample members and maximum of 60% of the frame size per industry sector within a state;
- Minimum (if possible) of 25 sample members per state; and
- Minimum (if possible) of 250 sample members and maximum of 60% of the frame size per industry sector at the census division level (see Figure 2-1).

A controlled sample selection algorithm developed at RTI[1] was iterentively used to allocate the sample subject to the above constraints, and the sample members were selected at random without replacement within a stratum. Frame and sample sizes for each stratum are shown in Table 2-2. It should be noted that sampling fractions in some strata reached or exceeded (due to imposition of the minimum sample size constraint) the 60% maximum sampling constraint.

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[1]Described in Chromy, J. R. (1979), Sequential Sample Selection Methods. American Statistical Association 1979 Proceedings of the Survey Methodology Section, pp. 401-406.

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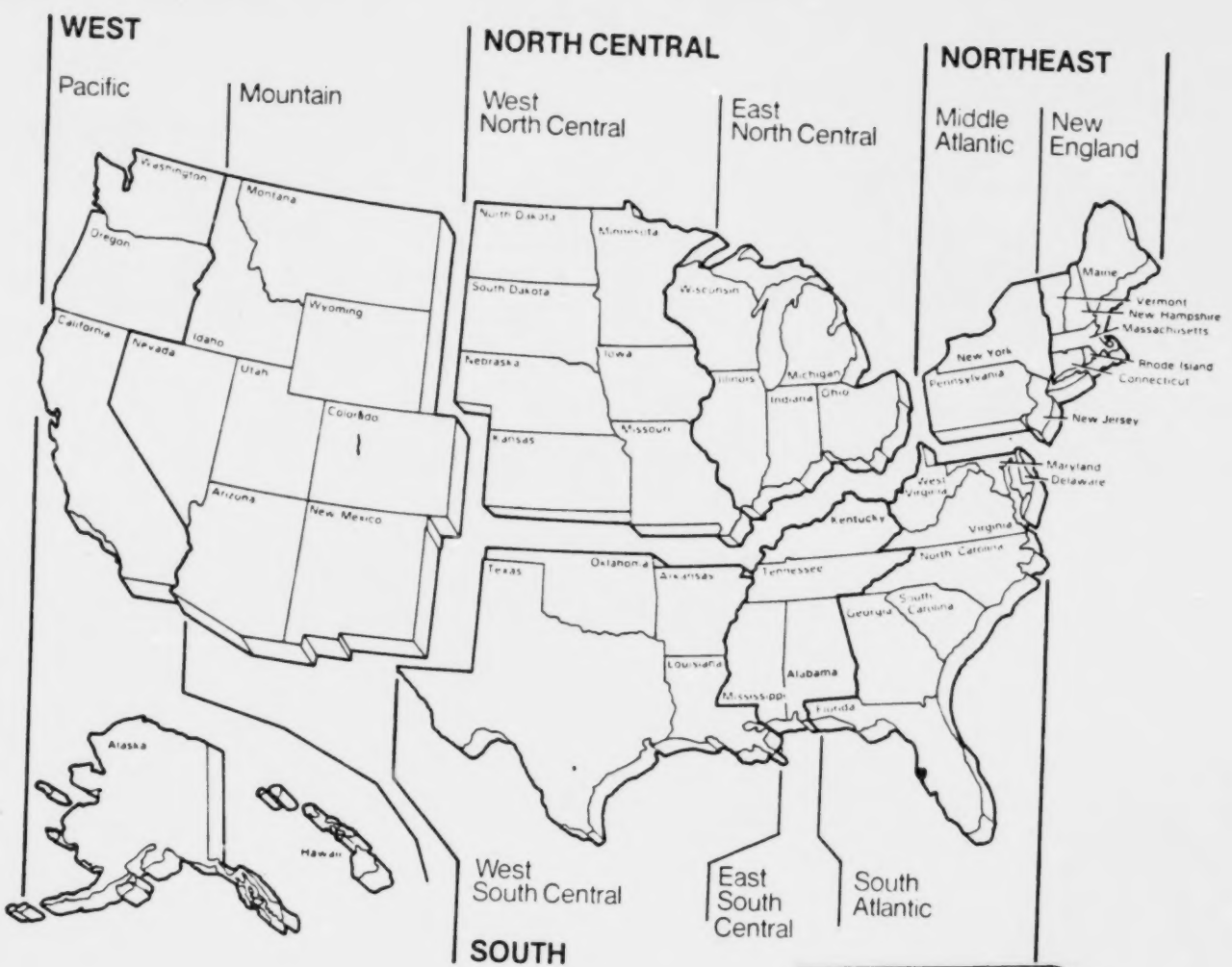

Figure 2-1

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Table 2-2. Mail State Frame and Sample Sizes

Reference State	Substratum[1]	Number on the Frame	Number Sampled
AL	001	99	60
AL	002	379	119
AL	003	54	22
AR	123	183	57
AR	211	38	14
AR	212	16	6
AR	213	29	11
CA	001	686	247
CA	002	1113	347
CA	003	371	126
CO	001	212	78
CO	002	42	26
CO	003	10	6
CT	002	150	89
CT	003	10	6
CT	211	252	91
CT	212	352	128
CT	213	72	27
DC	123	104	34
DC	211	13	7
DC	216	25	15
DE	001	39	20
DE	002	79	26
DE	134	14	5
FL	001	238	84
FL	002	363	112
FL	003	653	219
GA	001	237	84
GA	002	351	108
GA	003	81	27
HI	001	102	37
HI	123	89	29
IA	001	114	42
IA	002	241	76
IA	003	16	5
ID	114	54	20
ID	123	37	22
IL	001	566	206
IL	124	601	198
IN	002	329	103
IN	003	63	21
IN	211	33	12
IN	213	190	68
IN	215	80	29

Table 2-2. Mail State Frame and Sample Sizes
(continued)

Reference State	Substratum[1]	Number on the Frame	Number Sampled
KS	001	162	59
KS	002	207	65
KS	003	80	27
KY	001	153	92
KY	002	252	80
MD	003	25	9
MD	124	269	83
MD	212	48	17
MD	213	66	24
MD	217	51	18
ME	123	32	19
ME	211	18	8
ME	212	22	10
ME	213	13	6
MI	001	596	211
MI	003	40	13
MI	124	209	65
MN	001	197	71
MN	002	42	25
MO	001	339	134
MO	002	527	189
MO	003	192	70
MS	001	43	25
MS	002	236	75
MS	003	30	13
MT	002	13	8
MT	003	24	15
MT	114	63	23
NC	001	328	117
NC	002	341	105
NC	003	51	17
NH	123	22	15
NH	211	17	6
NH	212	13	6
NH	213	42	15
NJ	004	1218	405
NM	001	47	25
NM	002	123	73
NV	001	52	19
NV	123	26	16
NY	001	842	302
NY	124	953	301
OH	002	409	128
OH	003	67	22
OH	211	89	32

Table 2-2. Mail State Frame and Sample Sizes
(continued)

Reference State	Substratum[1]	Number on the Frame	Number Sampled
OH	212	268	95
OH	213	418	149
OK	001	265	95
OK	002	238	74
OK	134	224	75
OR	001	92	33
OR	002	101	32
OR	003	52	18
RI	002	29	18
RI	003	7	4
RI	213	44	16
RI	214	44	16
SC	001	108	39
SC	002	365	112
SC	003	66	22
SC	004	32	9
SD	001	48	21
SD	002	29	18
SD	003	7	5
TN	001	50	30
TN	002	266	84
TN	003	20	8
TX	001	177	68
TX	002	913	312
TX	134	1032	368
UT	004	98	54
VT	002	18	11
VT	003	7	4
VT	213	27	12
VT	214	20	9
WA	004	180	58
WI	001	130	47
WI	123	90	30
WY	004	47	28

[1]The substratum code was devised to indicate if the substratum was one of the original industry sector domains or if it was the result of a merger or subset of the original domains. The original domains were coded as: Tree/Lawn = 1, Structural = 2, Both = 3, Unknown = 4. The substratum code was created using the following algorithm;

substratum code = $X_1X_2X_3$, where

$X_1 =$

- 0 if substratum is one of the original domains
- 1 if substratum is the result of a merger of two original domains
- 2 if substratum is a subset of one original domain

$X_2X_3 =$

- $0j$ if $X_1 = 0$ and substratum is an original domain
- i_j if $X_1 = 1$ and substratum is a merger of domains i and j ($i<j$)
- $1K$ if $X_1 = 2$ and substratum is a subset k of domain 1,

k = 1, ..., 7. The subsets are based on specializations within the tree/lawn sector.

2.3.2 Sample Design in Telephone States

The sample design for both stages of sample selection in the telephone states is described in detail in Appendix A. Points of primary importance are as follows:

1. Stratification was used in both stages in an effort to guarantee adequate coverage of each of the industry sectors and states.

2. In order to provide approximately the same level of precision in the telephone states as was expected in the mail states, the goal of the first-stage sampling effort was to screen enough applicators to identify 75 "structural" and 75 "tree/lawn" pest control firms in each state.

3. Those applicators that served both sectors were assigned to only one of the sectors for the first-stage sample selection. There were 14 (i.e., 7 states x 2 sectors) first-stage strata.

4. First-stage sample allocations in each state were 300 applicators or 60% of the number of applicators on the state frame for the tree/lawn sector, and 200 applicators or 60% of the state frame for the structural sector.

5. First-stage sample selection within strata was at random without replacement.

6. The first-stage sample was partitioned into waves by state and sector. The waves were processed sequentially until the desired number of firms were identified.

7. Second-stage poststrata were defined within each first-stage stratum by industry sector as assessed by the first-stage respondent. Thirty-six of the 42 (i.e., 7 states x 2 frame sectors x 3 screening sectors) potential second-stage poststrata had one or more members.

8. Second-stage sample size allocation was made proportional to a size measure that estimated the number of unique firms in each poststratum, using the controlled selection algorithm mentioned in section 2.3.1. The size measure was based on first-stage sample characteristics, and assumed values for the average number of certified applicators in a firm (by sector). The allocation attempted to realize an overall self-weighting sample of firms (by sector and state).

9. Within poststrata, random sampling without replacement was used to select second-stage applicators.

The firm-level list provided by Louisiana for a portion of the pest control industry was not included in the two-stage design. A sample from this list was selected using a single phase stratified design. List elements were stratified into two industry sector strata. Sample sizes for these strata were allocated using the sampling rates for mail states in the same census division, and a sample selected using random sampling without replacement. For the structural sector, there were 402 elements on the frame, of which 145 were selected, and in the structural and tree/lawn sector, there were 12 frame elements and 6 sample members. Any elements that appeared on the firm-level list in Louisiana that also appeared on the applicator-level list were cleaned from the applicator list prior to the second stage of sampling.

2.4 Sample Design for the Nonresponse Followup

Based on cost, logistic, and schedule considerations, a decision was made to select 1320 firms for personal interview nonresponse followup, 330 in each census region. Within each mail state stratum and telephone state poststratum, two "eligible for followup" domains were defined based on "event status" (see section 4.4) as of July 31, 1982. Those sample members with an event status of 200 were assigned to the "nonrespondent" domain, and those with an event status of 108, 109, 208, or 209 were assigned to the "partial respondent" domains. Partial respondents were included in the followup in an attempt to obtain usage data from them.

Sample selection proceeded independently for each census region. Within each region, sample members eligible for followup were serpentined by state, industry sector, and eligibility domain. The sample was allocated in proportion to the number of members in each domain, with the constraint that a minimum of three members per domain be included in the

sample. Allocation was done using the controlled selection algorithm noted in section 2.3.1. Within each domain, selection was at random without replacement. Followup frame and sample sizes are given in Table 2-3.

Table 2-3. Frame and Sample Sizes for the Nonresponse Followup Subsampling

Census Region	Reference State	Substratum[1]	Number of Nonrespondents	Number of Partial Respondents	Sampled Nonrespondents	Sampled Partial Respondents
1	CT	002	59	5	14	1
	CT	003	4	0	4	0
	CT	211	47	6	12	1
	CT	212	69	3	16	1
	CT	213	10	1	4	1
	MA	311	43	3	11	1
	MA	312	1	0	1	0
	MA	313	6	0	4	0
	MA	321	2	0	2	0
	MA	322	22	1	7	0
	MA	323	6	0	5	0
	ME	123	12	4	5	1
	ME	211	4	0	4	0
	ME	212	5	0	4	0
	ME	213	3	0	3	0
	NH	123	10	0	5	0
	NH	211	5	0	5	0
	NH	212	1	0	1	0
	NH	213	10	2	4	1
	NJ	004	260	24	51	5
	NY	001	196	15	40	3
	NY	124	239	11	48	2
	PA	311	34	6	9	2
	PA	312	0	1	0	1
	PA	313	2	1	2	1
	PA	321	1	0	1	0
	PA	322	25	1	7	0
	PA	323	12	0	5	0
	RI	002	7	2	4	2
	RI	003	3	1	3	1
	RI	213	7	0	4	0
	RI	214	4	1	3	1
	VT	002	4	1	4	1
	VT	003	3	0	3	0
	VT	213	6	1	4	1
	VT	214	5	1	3	1
			1,127	91	302	28

Table 2-3. Frame and Sample Size for the Nonresponse Followup Subsampling (continued)

Census Region	Reference State	Substratum[1]	Number of Nonrespondents	Number of Partial Respondents	Sampled Nonrespondents	Sampled Partial Respondents
2	IA	001	29	3	7	1
	IA	002	51	9	9	2
	IA	003	4	0	4	0
	IL	001	116	11	18	1
	IL	124	155	10	23	2
	IN	002	76	4	12	0
	IN	003	16	2	5	1
	IN	211	8	0	5	0
	IN	213	46	4	9	1
	IN	215	14	1	5	0
	KS	001	42	4	8	1
	KS	002	49	4	9	1
	KS	003	19	0	6	0
	MI	001	140	8	21	1
	MI	003	7	2	3	2
	MI	124	48	5	9	1
	MN	001	30	7	7	1
	MN	002	15	2	5	1
	MO	001	91	4	14	1
	MO	002	146	9	21	1
	MO	003	56	2	11	0
	NE	311	25	4	6	1
	NE	312	1	0	1	0
	NE	313	2	0	2	0
	NE	322	9	0	5	0
	NE	323	2	0	2	0
	OH	002	98	5	16	0
	OH	003	14	1	5	0
	OH	211	22	0	7	0
	OH	212	69	2	12	0
	OH	213	96	10	16	1
	SD	001	11	0	5	0
	SD	002	6	3	3	2
	SD	003	1	3	1	3
	WI	001	28	5	6	1
	WI	123	20	3	5	1
			1562	127	303	27

Table 2-3. Frame and Sample Size for the Nonresponse Followup Subsampling (continued)

Census Region	Reference State	Substratum[1]	Number of Nonrespondents	Number of Partial Respondents	Sampled Nonrespondents	Sampled Partial Respondents
3	AL	001	33	4	5	1
	AL	002	86	4	8	0
	AL	003	15	2	4	1
	AR	123	44	3	6	1
	AR	211	11	0	4	0
	AR	212	5	0	4	0
	AR	213	7	0	4	0
	DC	123	23	0	5	0
	DC	211	5	0	4	0
	DC	216	5	2	3	1
	DE	001	5	0	4	0
	DE	002	15	4	4	1
	DE	134	3	0	3	0
	FL	001	51	3	7	0
	FL	002	90	4	8	0
	FL	003	152	11	12	1
	GA	001	47	3	6	0
	GA	002	67	4	7	1
	GA	003	20	4	4	1
	KY	001	54	3	6	0
	KY	002	62	4	7	0
	LA	311	10	1	4	1
	LA	332	111	6	10	0
	LA	333	5	1	3	1
	MD	003	4	0	4	0
	MD	124	55	4	6	1
	MD	212	6	0	4	0
	MD	213	11	2	4	1
	MD	217	8	0	4	0
	MS	001	12	0	4	0
	MS	002	45	5	6	0
	MS	003	7	3	3	2
	NC	001	44	3	6	0
	NC	002	79	6	8	1
	NC	003	8	2	3	1
	OK	001	69	3	7	0
	OK	002	62	1	7	1
	OK	134	53	4	7	0

Table 2-3. Frame and Sample Size for the Nonresponse Followup Subsampling (continued)

Census Region	Reference State	Substratum[1]	Number of Nonrespondents	Number of Partial Respondents	Sampled Nonrespondents	Sampled Partial Respondents
	SC	001	23	0	5	0
	SC	002	76	5	7	0
	SC	003	13	2	4	1
	SC	004	6	0	4	0
	TN	001	13	5	3	2
	TN	002	62	3	7	0
	TN	003	5	0	4	0
3	TX	001	45	4	6	1
	TX	002	260	4	17	0
	TX	134	289	11	19	1
	VA	311	20	1	4	0
	VA	312	1	0	1	0
	VA	313	1	0	1	0
	VA	322	31	3	5	1
	VA	323	6	0	4	0
	WV	311	5	0	4	0
	WV	322	16	1	4	1
	WV	323	0	2	0	2
			2262	137	304	26
	AZ	311	4	0	4	0
	AZ	312	1	0	1	0
	AZ	321	4	0	4	0
	AZ	322	17	1	8	0
	AZ	323	7	0	5	0
	CA	001	122	13	37	4
	CA	002	215	11	63	3
	CA	003	83	3	26	1
	CO	001	48	2	16	1
	CO	002	13	4	6	2
	CO	003	4	0	4	0
	HI	001	16	0	7	0
	HI	123	23	0	9	0
	ID	114	13	0	7	0
	ID	123	14	4	6	1
4						

Table 2-3. Frame and Sample Size for the Nonresponse Followup Subsampling (continued)

Census Region	Reference State	Substratum[1]	Number of Nonrespondents	Number of Partial Respondents	Sampled Nonrespondents	Sampled Partial Respondents
	MT	002	5	0	5	0
	MT	003	9	2	4	1
	MT	114	13	1	6	1
	NM	001	17	1	7	1
	NM	002	44	5	15	2
	NV	001	11	2	5	1
	NV	123	10	0	6	0
	OR	001	20	0	9	0
	OR	002	18	2	7	1
	OR	003	9	2	5	1
	UT	004	40	0	14	0
	WA	004	45	3	15	2
	WY	004	14	1	7	0
			839	57	308	22
			5790	412	1217	103

[1]See Table 2-2.

3. QUESTIONNAIRE DEVELOPMENT AND DESIGN

One of RTI's first activities for NUPAS was the development and design of a questionnaire based on the draft versions prepared by the trade associations. The following sections discuss RTI efforts associated with the preparation of this instrument.

3.1 Review of Trade Association Questionnaires

It was anticipated at the onset of RTI involvement with NUPAS that a single composite questionaire would be necessary to assure comparability of data and to permit analyses and reporting according to EPA desires and needs. To develop a single questionnaire, RTI thoroughly reviewed the draft versions from EPA and the trade associations. The evaluation of the three industry-specific instruments included an assessment of respondent burden, underlying measurement error process (variability and potential biases), and choice of sampling/analysis unit.

3.1.1 Comparability of Draft Questionnaires

To consolidate the three questionnaires it was necessary to first identify those data elements that were present in all drafts; this would lead to a set of core questions that would serve as the central part of the survey document. From that core, additional questions of special interest to each trade association could be evaluated and considered for inclusion. At minimum, the set of core questions had to be assessed for consistent and standard terminology across the different NUPAS industries.

One of the key factors in questionnaire development is the consideration of data entry needs and requirements. Since the Committee had little expertise in data entry and programming, the drafts were not developed with this in mind. Therefore, to facilitate data entry, substantial reformatting was necessary. Many draft questions were open-ended and not suitably

directed to the most pertinent issues. While the various trade associations desired much of the same information, their approach to asking the questions (especially in wording) was different. RTI reviewed each "key" question and the approach taken by each association to that question. RTI then attempted to reconstruct the question so that (1) it would be understood by all respondents regardless of their point of reference, and (2) that this understanding would result in the desired responses.

3.1.2 Consolidation to One Questionnaire

One of the paramount issues when consolidation efforts began was the amount of time required to complete the questionnaire. Each draft questionnaire contained many questions of marginal interest to all organizations, and these had to be deleted. Since the necessary set of "key" questions was large, superfluous questions only added to the response burden. In addition, certain items were deleted from the draft versions to meet budget constraints whereas others were added to enhance the analytic aspects of the survey.

Once the set of "key" questions were identified, the questions could be structured. Question terminology and wording was developed, appropriate response options and codes were identified, and questions were formatted for the best flow and consistency.

3.2 Eligibility and Usage Questions

There were three key sections to the NUPAS questionnaire: (1) the questions concerning whether or not a firm selected in the sample was actually eligible to participate, (2) the questions that ascertained total pesticide product usage, and (3) the questions that would eventually be used to weight the data. These questions were essential to the planned analyses and reporting.

To determine eligibility, several steps had to be developed to (1) make sure the sampling information as shown on the computer-generated address label was correct and complete, (2) define "firm" as it was used in the questionnaire, and (3) confirm that the firm furnished pest control services on a commmercial basis, i.e., charged a fee for services rendered. Figure 3-1 shows the first page of the survey questionnaire in its final version; the information in the box at the top left represents that which was computer-generated onto an adhesive label and affixed to the questionnaire before mailing. Questions 1, 2, and 3 determined the firm's eligibility status, based on RTI's knowledge of the industry. It should be noted that during the sample design and selection phase, RTI learned that the eligibility issue was not as simple as one might imagine. Had prescreening efforts not been conducted before the sample selection was completed, many firms would have had difficulty responding or would have answered incorrectly (through no fault of their own).

A further difficulty became apparent when RTI learned that the state lists of certified applicators were not always consistent with regard to the certification of individuals versus firms or the inclusion of certain specializations, such as commodity fumigation and right-of-way pest control. These specialties may have appeared on some lists but not on others (See Chapter 2). Finally, RTI found inconsistency in the reporting of urban and rural/agricultural firms; the NUPAS effort was only concerned with those firms dealing with the urban/ non-farmer sector.

As a result of the problems dealing with firm eligibility and the necessity to reconstruct for questions and/or instructions so the respondents could determine whether their firm should respond, this part of the survey design effort exceeded time and cost estimates. Because of this, the schedule for questionnaire development slipped by several weeks.

RTI ID Number
Name
Street Address or P.O. Box
City, State ZIP

***Reference State: _____ ***

1981 Business License Number: _____

The information you provide will be held in strict confidence and the results will be reported only in statistical summaries. No information that would identify an individual or firm will be released or reported.

ALL QUESTIONS REFER COLLECTIVELY TO BUSINESS LOCATIONS OPERATING WITHIN THE REFERENCE STATE UNDER THE BUSINESS NAME IDENTIFIED ON THE ABOVE LABEL. SUCH BUSINESS LOCATIONS WITHIN THE STATE WILL HEREAFTER BE REFERRED TO AS THE "FIRM". PLEASE CIRCLE YOUR ANSWER AND FOLLOW THE APPROPRIATE ARROW OR ENTER THE INFORMATION IN THE SPACE PROVIDED.

A. FIRM IDENTIFICATION INFORMATION

1. Is the information printed on the above label complete and correct?

   Yes . . . . . 01 (GO TO Q.3)

   No. 02

2. Correct or complete information as necessary:

   Firm Name: _____

   Business Address
   or P.O. Box: _____

   City: _____ State: _____ ZIP: _____

   Current Business License Number: _____

   (GO TO Q.3)

3. Does your firm furnish pest control services on a commercial basis (i.e., for a fee)?

   Yes . . . . . 01 (GO TO Q.4)

   No. 02

   STOP. THANK YOU FOR YOUR TIME. RETURN THE QUESTIONNAIRE IN THE ENVELOPE PROVIDED.

4. How long has your firm provided pest control services in the reference state identified on the above label?

   Length of time: _____

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Figure 3-1

The key questions that asked about pesticide usage also created unexpected problems and exceeded the estimated development time. Figure 3-2 shows the primary usage questions and instructions as they appeared in the questionnaire. Although the final questions/instructions seem relatively simple, the development of wording and structure that would obtain the desired information was quite difficult. Little was known about the records (i.e., purchase, usage, or other) that were maintained by the firms; little was also known about the level of detail or accuracy of the records that were kept. The problem of reporting all usage for every possible firm location (discussed in later sections in more detail) also created difficulties in question development. Although there was some assurance that most firms would probably have the EPA Registration Number available (essential for analyses), RTI felt that other data should be requested (product name and formulation) in case the number was not kept on file.

3.3 Reporting Problems

While reporting problems relate primarily to sample frame construction, they do influence questionnaire design, and the two are often interrelated. Because the survey was aimed at the firm level, the reporting also had to be by firm. However, some states furnished lists of certified individual applicators, whereas other states furnished lists of firms, depending on their licensing structure. The individual-level lists had to be transformed into firm-level lists before the final sample could be selected (see section 2.2.3). When this and other problems became apparent, the questionnaire design team realized that although this transformation process could reduce the reporting problem, all cases might not be resolved. Therefore, the questionnaire was altered to incorporate steps to handle such situations.

D. PESTICIDE USAGE INFORMATION

22. The questions in this section concern total pesticide products purchased for usage during calendar year 1981 or your most recent fiscal year. Guidelines for furnishing this information include:

- Usage information for calendar year 1981 is preferred.
- Products should be identified as in the two examples below by EPA Reg. Number OR by complete product name and formulation (if EPA Reg. Number not available). Total amounts used should show units of measure (e.g., pounds, gallons, etc.). Be as specific in listing this information as you would if ordering from your supplier.
- Information requested is for all business locations operating within the reference state under the firm name identified on the above label. If this information can only be reported at another level (e.g., information available from parent company for entire region/state and not for firm identified by the above label), check this box → ☐ and go to Question 26.

Complete Pesticide Product Name	Formulation	EPA Reg. No.	(CIRCLE ONE) Ready to Use	OR	Concentrate	Total Amount Purchased Product Used
Dursban	2E	7122-68	R		(C)	40 gallons
Talon	G	10182-39	(R)		C	120 pounds
1.			R		C	
2.			R		C	
3.			R		C	
4.			R		C	
5.			R		C	
6.			R		C	
7.			R		C	
8.			R		C	
9.			R		C	

Figure 3-2

(Continued on next page)

This situation also created possible multiplicity situations when a firm was licensed in adjoining states under a different license for each state. Should the firm be selected in each state, it was necessary to include instructions in the questionnaire that would assure reporting for the firm's activities under the license number in the state shown on the address label. The instructions preceding Section A attempted to define 'firm' according to survey reporting requirements. RTI had no interest in sub-state usage since the most accurate usage reporting would theoretically be obtained from the highest firm aggregate. When reviewing the state lists, three operational problems surfaced: (1) all firm business locations were not included on the lists which created sample coverage problems when attempting to restrict the firm to one address; (2) the address shown might be the home address of a licensed individual rather than that of a firm, based on the way a state chose to certify which compounded the problems of defining the reference set, and (3) the entity shown might not have the ability to respond--most apparent with subsidiaries of industry giants--since the requested information would be maintained at a higher corporate level.

There was also a problem with firms that had split and/or merged within the reporting period (calendar year 1981 or latest fiscal year). This affected reporting of data and had the potential to create problems with response weighting and analyses. Likewise, it was necessary to know precisely the firm's service area if (1) it covered multiple states through several locations or (2) it covered the entire state or several counties with more than one location.) It was also necessary to include questions that would determine whether the firm offered services through firms having other names and/or locations (since RTI had no ability to recognize such

situations unless the license numbers were available, which was not always the case), and whether all locations operated under the license number on the label, if shown. When cleaning the lists, RTI assumed that the latter situation was true.

While the sample selection team worked diligently before the final sample was selected to remove elements that were obviously not members of the target population as well as obvious duplicate elements within a state list, the questionnaire development team felt it necessary to include questions that could identify firms that eluded or were not amenable to this removal process. Because an extensive effort was involved, again the schedule slipped significantly and the costs escalated.

When RTI realized that some firms could not report pesticide sales and usage information at the level requested (by the firm name and license number shown on the label), two sets of instructions containing an "opt-out" skip pattern were designed (see Figures 3-2 and 3-3). The skip box in Question 22 was designed to avoid reposting of usage data that was (1) not specific to the reference state or (2) not for locations having a different name. This instruction was either misunderstood or ignored by most respondents. Also, because little was known about certain areas of questioning, especially related to what kinds of responses to anticipate, several questions were designed to be "open-ended" and allowed the respondent to enter a narrative response rather than circle a response option.

The questionnaire went through multiple drafts and each was sent to EPA and the trade associations for review. Once comments and/or recommendations for additions or changes were received by RTI, further modifications were made until the final version was submitted (see Appendix A of the Overview and Results Volume) .

C. PESTICIDE SALES INFORMATION

The questions in this section concern sales volume during calendar year 1981 or your most recent fiscal year. Guidelines for furnishing this information include:

- Sales volume information for calendar year 1981 is preferred.
- Report all information for the same time period. Please show any variations in the appropriate margin(s).
- Information requested is for all business locations operating within the reference state under the firm name identified on the above label. If this information can only be reported at another level (e.g., information available from parent company for entire region/state and not for firm identified by the above label), check this box → ☐ and go to Question 26.

18. What were the total gross sales of your firm for all activities in 1981 (or your most recent fiscal year)?

Less than $25,000 01
$25,000 to $49,999. 02
$50,000 to $99,999. 03
$100,000 to $199,999. 04
$200,000 to $499,999. 05
$500,000 to $999,999. 06
$1,000,000 to $5,000,000. 07
Over $5,000,000 08

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19. What were your total sales during 1981 (or most recent fiscal year) for pest control (including termite) services only (i.e., exclude retail product sales, tree trimming, etc.)?

Less than $25,000 01
$25,000 to $49,999. 02
$50,000 to $99,999. 03
$100,000 to $199,999. 04
$200,000 to $499,999. 05
$500,000 to $999,999. 06
$1,000,000 to $5,000,000. 07
Over $5,000,000 08

Figure 3-3

3.4 Pretest Activities

RTI suggested that a thorough pretest of the questionnaire would identify potential problem areas in the document. Since this activity was not included in the original schedule and would have resulted in a further delay in implementation of the survey, EPA rejected the idea. Instead, EPA and the trade associations agreed that review committees within each association would be responsible for a "pretest review" of the drafts and final questionnaire. Thus, RTI did not conduct a formal and standard pretest of the survey document. It was anticipated that the "pretest review" would involve approximately 75 highly qualified professionals who were extremely knowledgeable of the industry.

In retrospect, RTI realized that this decision to forego formal pretesting was not in the best interest of the survey. While peer review among professionals within the trade associations was extremely valuable in isolating poor question wording and other problems, a pretest of actual pest control operators would have furnished the most valuable information and would have improved questionnaire development. Problems concerning firms that operated at several locations, in multiple states, or under different names with the same license number would have surfaced at that time. Also, subsequent problems concerning usage reporting would have been identified and changes could have been made in the questionnaire before it was finalized.

4. PREPARATIONS FOR SURVEY IMPLEMENTATION

In preparation for any survey, especially of this magnitude, all procedures and other advance-planning activities must be organized and well developed. NUPAS required much advance preparations which are discussed in the following sections.

4.1 Trade Association Media Coverage

In preparation for the survey, the trade associations conducted a media campaign, the intent of which was to alert their membership of the upcoming survey, stress its importance for EPA and the benefits that the Associations could derive from the data, and encourage participation. This media campaign was to take the form of letters to state regulatory agencies, telephone calls to influential persons at the state and local level, announcements in industry newsletters, brochures and other publications, and ads in trade journals. In addition, association representatives to the Planning Committee were to speak about the survey at several trade association conventions. In his editorial column for the NPCA official publication, the Association's Director of Public Affairs (who was a member of the Planning Committee) devoted several issues to the survey and stressed the importance of cooperation by the industry.[1]

The cooperating trade associations estimated that only about 30 percent of the licensed individuals/firms in the U.S. were members of their organizations. Therefore, part of the media campaign emphasis centered on small firms and non-association member firms. Their cooperation was necessary to guarantee a better industry/sector profile.

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[1]Copies of letters, ads, and other publicity documents are in RTI Report #RTI/2764/08-01S.

When RTI became involved in NUPAS, the project staff were assured that the above mentioned activities had taken place or would take place before the first questionnaire was mailed. As it turned out, this was not exactly true. While some advance publicity had taken place, the extent of the campaign had been overstated. Some contacts with association officials had begun and several state agencies had been alerted to the survey, but most of these activities had been in an "unofficial" manner. Discussions at association meetings were not formal presentations but, rather, informal "chats" with various people in attendance.

In a survey of this nature, particularly with an industry not previously surveyed, advance publicity is essential. The timing of the survey was such that the questionnaires were mailed when the respondents were beginning their busy season. Had extensive advance publicity been in place, more respondents would have been expecting the questionnaire and possibly would have made arrangements to begin gathering the requested information before receipt of the questionnaire. As it turned out (and discussed in detail in later sections), the response rate was much lower than anticipated; advance publicity to the extent originally planned could possibly have resulted in a significantly higher response, eliminating the need for much of the expensive and time consuming follow-up activities required later.

4.2 Development of the Final Schedule

Once the advance planning was in place and project staff understood the problems inherent in NUPAS, it was possible to develop a more realistic schedule of activities that, with perhaps minor changes because of unexpected situations, could be met. This schedule was developed through

consultation with EPA officials, representatives from the trade associations, and key project staff at RTI; Table 4-1 shows the scheduled milestones and completion dates.

4.3 Telephone Screening

As discussed previously, NUPAS was designed to obtain information at the firm level. In 42 of the 49 participating states, firm-level sampling frames were constructed from state lists of registered pesticide businesses. In the remaining seven (7) states,[2] pesticide applicators rather than businesses were registered. A two-phase sample design was necessary to generate a frame of pesticide businesses for these states. The first phase was the sample design and selection (see Chapter 2). The selected applicators would then be interviewed by telephone. During the interview their employees would be identified and eligiblity for NUPAS determined. All eligible firms then defined the second phase sampling frame. The NUPAS questionnaire was mailed to all second-stage firms.

A questionnaire (see Appendix B) was developed for the telephone survey--the primary thrust of this document was to identify the firm(s) that employed the licensee. Additional information was obtained about business activities.

Once the questionnaire was completed and data collection plans formulated, the telephone interviewers were trained. Their first task was to obtain telephone numbers if not available from state lists. This was problematical since the lists were from 1981 and outdated. Also, some listings were for firms and some for individuals. Therefore, telephone numbers were unavailable or RTI was otherwise unable to contact approxi-

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[2]Arizona, Louisiana, Nebraska, Massachusetts, Pennsylvania, Virginia, and West Virginia.

Table 4-1. Schedule of Major Implementation Activities on NUPAS

Activity Description	Completion Date
Questionnaire development.	15 March, 1982
Construction of computerized frame of firms.[1]	22 March, 1982
Receipt of state letters requesting that NUPAS be conducted.[2]	31 March, 1982
First mailout to 8,100 firms in 42 states.	2 April, 1982
Telephone screening of 2,500 applicators in seven supplementary states.[3]	14 April, 1982
First mailout to 620 additional firms in seven supplementary states.[4]	23 April, 1982
Media campaign (e.g., advertisements in trade journals, announcement at meeting, etc).	30 Sept., 1982
Prompting letters from RTI sent to first mailout nonrespondents under AAPCO letterhead/signature.[5]	16 June, 1982
Computer-generated Thank-you/Reminder postcards sent to all firms receiving first mailout.	23 June, 1982
Second mailout of questionnaire to current non-respondents.	4 July, 1982
Telephone prompting of all nonrespondents as of 31 July, 1982.	20 Aug., 1982
Selection of nonresponse follow-up sample for AARP (1,320 firms)	4 Aug., 1982
Enumeration of nonresponse subsample by AARP.	15 Oct., 1982
Contact of selected industry giants to solicit information in alternative format (if necessary).	31 Oct., 1982

[1]Only for 42 states in which a firm name appeared to be identifiable on the licensing list(s).

[2]North Dakota and Alaska declined to participate in NUPAS.

[3]Supplementary sample was selected in Massachusetts, Pennsylvania, Virginia, West Virginia, Lousiana, Nebraska and Arizona.

[4]An additional 116 firms in the supplementary states were sent questionnaires as the result of the nonresponse follow-up efforts on NUPAS.

[5]One half of the states refused to grant permission for same and could not be prompted in this fashion.

mately 1,100 listings. A mail screening questionnaire (see Appendix C) was developed for these cases.

The general results of this activity are shown in Table 4-2. The final detailed documentation of the effort is in Appendix A.

4.4 Survey Control System

4.4.1 Overview

To monitor the status of each NUPAS sampled case, a survey control system was implemented. The purpose of the NUPAS control system was not only to monitor the status of survey records but also to furnish early detection of problems. The control system, a mixture of computer software, data files, and procedures, monitored the operational aspects of the NUPAS data collection effort. In general, the control system maintained a record of the current status of each sample firm (hereafter referred to as "case") in the NUPAS survey. To accomplish this task, event codes associated with selected activities (such as receipt of data or refusal to participate) were maintained in the control file records. Events included both actions taken (such as mailing out questionnaires), and delay periods (such as expected waiting times for materials to return from the field). If an action was not taken or an anticipated event did not occur, the control system software alerted the project staff. The system also maintained historical data on all cases and regularly produced statistics describing the volume of data received and processed through the defined steps.

4.4.2 Control File

The control file was generated after the NUPAS sample was drawn and contained one record for each sampled case. Because the control file was used to generate subsequent mailout materials, all applicable identification (i.e., for location, contact, and analysis) were maintained on the

Table 4-2. NUPAS Telephone Screening Results

State	Sample Size	No Phone Listing	Unable to Contact	Refusals	Responding Applicators	
					Eligible	Ineligible
Arizona	345	126	56	7	68	88
Louisiana	166	55	24	8	23	56
Nebraska	400	31	78	5	109	177
Massachusetts	500	111	52	14	172	151
Pennsylavania	500	193	71	11	133	92
Virginia	500	155	72	0	123	150
West Virginia	147	46	23	3	63	12
Total	2,588	717	376	48	691	726

file. The data items and format of the control file are given in Table 4-3.

4.4.3 Event Processing

The NUPAS events status codes monitored those aspects of the survey that were important to field operations and to the Project Director. Table 4-4 provides a summary of the NUPAS events. The events were sent to the the system by both computer and manual processing depending on the function. Events were generated by machine for events 100, 200, and 300 after labels and assignments were printed, and event 500 was generated by machine when the keyed data had been transmitted to the Triangle Universitites Computer Center (TUCC). The remaining events were sent manually, i.e., keyed in, when an event occurred for a given case.

The control system not only recorded event status, but also checked to ensure that an event was received in proper sequence. [Example: A case evented as a Wave 1 undeliverable (102), could not then receive a Wave 1 completed questionnaire (110) event. Futhermore, the case could only receive a completed event in Wave 2 if the system had been notified of a Wave 2 remailing (event 200)]. Checks such as these were made for all events as the system processed them. If an inconsistency was found, the event was rejected and an error report was printed and given to the project staff for resolution.

The case ID numbers and event numbers were assigned check-digits to minimize keying errors when sending status codes to the system. A check digit, mathematically computed for each ID and event number, had to be keyed on the event record. If two numbers were mistakenly transposed in keying (i.e., 201-1 was keyed as 210-1) the machine would catch the error due to the incorrect check digit (the check digit for 210 is 5), and notify the keyer to rekey the number.

Table 4-3. Control System Format

VARIABLE NAME	LENGTH	DESCRIPTION
RTIID	7	RTI ID #
STATEGR	2	STATE GRANTING LICENSE
LICENSE	10	LICENSE NUMBER
ESTBNAME	35	ESTABLISHMENT NAME
INDNAM	1	INDIVIDUAL NAME INDICATOR
ADDRESS	40	ESTABLISHMENT ADDRESS
CITY	20	CITY
STATEMA	2	STATE (MAILING)
ZIP	5	ZIP CODE
NASSOC	2	NUMBER OF INDIVIDUALS ASSOC. W/ESTAB.
ESTBTYPE	1	TYPE OF ESTABLISHMENT
AREACODE	3	AREA CODE
PHONE	7	PHONE NUMBER
LICCAT1	2	LICENSE CATEGORY #1
LICCAT2	2	LICENSE CATEGORY #2
LICCAT3	2	LICENSE CATEGORY #3
LICCAT4	2	LICENSE CATEGORY #4
LICCAT5	2	LICENSE CATEGORY #5
LICCAT6	2	LICENSE CATEGORY #6
LICCAT7	2	LICENSE CATEGORY #7
LICCAT8	2	LICENSE CATEGORY #8
LICCAT9	2	LICENSE CATEGORY #9
SRTCAT1	1	CATEGORY #1-IN SORTED ORDER
SRTCAT2	1	CATEGORY #2-IN SORTED ORDER
SRTCAT3	1	CATEGORY #3-IN SORTED ORDER
SRTCAT4	1	CATEGORY #4-IN SORTED ORDER
SRTCAT5	1	CATEGORY #5-IN SORTED ORDER
SRTCAT6	1	CATEGORY #6-IN SORTED ORDER
SRTCAT7	1	CATEGORY #7-IN SORTED ORDER
SRTCAT8	1	CATEGORY #8-IN SORTED ORDER
SRTCAT9	1	CATEGORY #9-IN SORTED ORDER
EPAREGN	2	EPA REGION
CENSREGN	1	CENSUS REGION
CENSDIVN	1	CENSUS DIVISION
STATECDE	2	STATE CODE
SEQUENCE	4	SEQ. #
SAMPDOMN	3	SAMPLE DOMAIN
MAILBTCH	4	MAILING BATCH
INDRYCAT	1	INDUSTRY CATEGORY
REGMA	1	CENSUS REGION (MAILING)
DIVMA	1	CENSUS DIVISION (MAILING)
AARPSAMP	1	AARP SAMPLE INDICATOR
NATIONAL	1	NATIONAL COMPANY IND.
TELRESLT	2	TELEPHONE PROMPTING RESULTS

(LICCAT1–LICCAT9: 3, 3A, 3B, 7, 7A, 7B, 7C, 7D)

Table 4-3. Control System Format (continued)

VARIABLE NAME	LENGTH	DESCRIPTION
UNUSED	14	BLANK
CUREVENT	3	CURRENT EVENT
CURDATE	6	CURRENT DATE
CURBATCH	5	CURRENT BATCH
-		
-		
-		
EVENT HISTORY VARIABLES TO END OF FILE		

Table 4-4. NUPAS Event Status Codes

Wave 1	Wave 2	Nonresponse Followup	Description
90	*	*	Sampled, not mailed
100	200	300	In the field
101	201	301	Received at RTI, action pending
102	202	302	Undeliverable/Unable to contact
103	203	303	Incomplete - out of business
104, 105	204, 205	304, 305	Incomplete - refused
106, 107	206, 207	306, 307	Ineligible
108, 109	208, 209	308, 309	Partially complete questionnaire
110, 111	210, 211	310, 311	Complete questionnaire
500	500	500	Data at TUCC

*Not applicable.

4.4.4 Usage

In a mail survey such as NUPAS, the control system was helpful in maintaining not only the status of each case, but also in providing summary information used in determining follow-up procedures. Because the system was up-to-date and monitored an event as to the date on which it occurred, the system was able to schedule follow-up on a case-by-case basis when needed.

The summary reports generated by the control system allowed the Project Director to monitor the overall progress and the response rate of NUPAS. In addition, individual cases at a certain event could be listed to assist the follow-up procedures, i.e., lists of the undeliverable questionnaires could be used as assignments for telephone follow-up to obtain the correct address. When the Wave 2 mailout and the AARP follow-up assignments were made, the control system file was used to generate all necessary materials for those cases at the designated events. Because the control file maintained strata information in addition to status information, it was also used in drawing the AARP follow-up sample and was the basis for subsequently developing the analysis file/specifications.

The importance of the control system cannot be overstated. It provides the mechanism for summarizing the data collection status at any point in time and is a prerequisite to adequate survey management.

4.5 Preparation of Survey Materials

Once the major planning issues had been resolved, project staff began the task of preparing to conduct NUPAS. These activities, spanning finalization of the questionnaire to data receipt and edit plans, are discussed in the following sections.

4.5.1 Reproduction of Survey Questionnaire

After multiple revisions, the questionnaire was completed and ready for printing. Because expenditures to this point exceeded the original estimates, it was essential to reproduce the questionnaire at the lowest possible cost and as quickly as possible. Therefore, a decision was made to (1) use RTI's in-house word processing equipment rather than expensive type-setting, and (2) use RTI's reproduction facilities rather than an outside printer.

Since EPA had requested and received letters from the sample states asking that the survey be conducted, OMB approval was not needed. So once the questionnaire was in final form, it was sent to the RTI duplicating center for immediate printing.

4.5.2 Development of the Cover Letter

The cover letter that was to accompany the questionnaires was prepared with extreme care. Since the letter was to be on survey stationery, RTI and the trade associations felt that it should meet the following standards: (1) it should be concise yet cover all necessary points; (2) it should clearly show the role of the trade associations in the survey; (3) it should stress the importance of full cooperation; (4) it should stress confidentiality and furnish the name of an RTI employee who could be contacted in case of questions; and (5) it should clearly indicate how the data would benefit the industry. Further, it was felt that the Committee representatives from NPCA, NAA, and PLCAA should jointly sign the letter. EPA was not referenced in the letter nor did an agency official's signature appear. Once the wording was approved, the letter was printed at RTI after the letterhead paper was received.

4.5.3 Development of Data Receipt Plans

RTI held meetings to develop plans for handling the completed questionnaires. A survey assistant was given the responsibility for data receipt and record keeping. In addition to the control system that would have the capability of furnishing computer reports of document status, a back-up manual check-in system was deemed necessary. Therefore, the survey assistant was instructed to develop a check-in log wherein the status of each sample firm would be documented. The survey specialist responsible for data collection was given the task of preparing the documentation for this process.

4.5.4 Development of Scan-Edit Specifications

Data from returned questionnaires had to be classified as partially acceptable or complete; to do this, certain "key" questions had to be answered. In addition, questionnaires were classified as coming from firm headquarters as opposed to subsidiaries or other branches (this was part of the control system documentation). This also required the review of certain questions. These reviews became part of the data receipt operation, and they were performed at the time of questionnaire check-in and entry into the manual log system. A more detailed edit process followed and will be discussed in Technical Volume II.

4.5.5 Development of Plans for Handling Special Requests

During most surveys, especially mail surveys, respondents will from time to time have questions concerning certain items, the purpose of the survey, or other issues. Procedures for handling these questions, either by telephone or mail, must be in place before respondents receive the first mailing. Based on past experience with data collection efforts, RTI was able to anticipate many of the problems/questions that would be encountered

with NUPAS and began preparation of plans for handling same. Since the name of the survey specialist responsible for data collection appeared in the questionnaire along with a toll-free number for respondents to dial if there were questions or problems, all telephone inquiries were routed to the survey specialist. Likewise, most mail requests came to the survey specialist although most cases were then directed to the survey assistant for handling. Other special requests or problems of a substantive or quantitative nature were handled by the project director. On occasion, questions were referred to EPA or trade association staff, as necessary. The plans for handling these situations were developed by RTI and in place by the time of questionnaire mailing.

5. IMPLEMENTATION OF SURVEY PROCEDURES

5.1 Questionnaire Mailout

Questionnaire mailout was not as straightforward as one might expect. Because of problems encountered with the state lists and the delays in "cleaning" the lists, all questionnaires could not be mailed at the same time. Therefore, a phased mailing approach was used; as sampling personnel completed the final review and approved a state listing, computer personnel generated the appropriate labels by batches and the mailing process began.

A sample of 8,100 firms was selected from the original mail state frame, and as each (or a group) of the state's lists was completed, the questionnaires for the state were mailed. A total of 15 batches were required to complete this process with each batch containing between 40 and 1,041 firms.

The mailout activities began during the week of 29 March 1982 and the last batch from the original frame was mailed on Friday, 2 April 1982. Because the number of cases varied dramatically by batch, it was extremely difficult to project staff needs for the mailout process. Thus, to assure adequate staff for the larger batches, it was necessary to retain full staff even when there were fewer than 100 cases in a batch. However, the resulting inefficiences were unavoidable since the mailout schedule was rigid.

In the seven states for which a firm-level list could not be directly generated (Arizona, Louisiana, Massachusetts, Nebraska, Pennsylvania, Virginia, and West Virginia), a two-phase sampling scheme was devised. Because this task was time consuming, the processing of the second stage

frame was postponed until all seven states were completed. Once completed, a sample of 620 firms was then selected from these states; the mailout process for this group was completed by 23 April 1982.

As the mailing labels were generated and delivered to the mailout staff, the batch number and inclusive ID ranges in the batch were logged onto a master control form and small groups of labels were assigned to a survey clerk (the inclusive firm identification numbers in the assigned group and survey clerk's name were entered on the master control form). Three sets of labels were generated for each sample firm: (1) a control label (to be placed on the questionnaire) containing the firm ID number, firm name and address, the state issuing the license number, and the 1981 business license number, if known; (2) a mailing label (to be placed on the out-going envelope) containing the firm ID number and the firm name and address; and (3) a return address label (to be placed on the return envelope) containing the firm ID number and firm name and address. The clerk had to take extreme care to make sure that the correct labels were on each item in the mailout package. Once the clerk completed a group, he/she returned the materials ready for mailing to the activity supervisor.

The supervisor was responsible for the quality control check of the completed groups. This consisted of randomly pulling a 10 percent sample of envelopes in each batch to see if the appropriate labels had been placed on the appropriate documents and that all required documents were present. Any problems were brought to the attention of the responsible clerk and corrected before mailout. Had this been a consistent problem the clerk responsible for the error would have been replaced. However, this did not occur. This quality control procedure was followed throughout the mailout period for each batch.

5.2 Handling Special Requests and Problems

As noted briefly earlier in this report, RTI anticipated that during the course of the suvey there would be questions from sample firms. To handle such questions, RTI developed specific procedures. Most of the questions would be handled by either the project survey assistant or the survey specialist in charge of data collection. Questions or problems of an analytical or quantitative nature were referred to the project director.

Both the questionnaire and the cover letter informed the respondents that they could phone the RTI toll-free number if there were questions or problems. Telephone calls were routed directly to the project survey specialist and he or the survey assistant would handle them, depending on the nature of the problem. Telephone summary sheets were completed for each incoming call. The information recorded on these sheets included the name of the person calling, the nature of the request or problem, and any actions taken by RTI.

Some respondents chose to write rather than phone. In such cases, the letters were reviewed by the project survey assistant who decided what action to take or to whom the request should be forwarded. All written requests and subsequent actions were filed for reference.

5.3 Data Receipt

One of the most important aspects of the NUPAS implementation was the procedure for receiving and processing incoming data. Through the use of the manual log system and the control system, follow-up activities were activated, response problems identified, and possible remedial actions formulated. These procedures are discussed in the following sections.

5.3.1 Questionnaire Check-In Procedures

The manual check-in log form that was used for data receipt was computer-generated. This form was printed on multiple copy paper so simultaneous copies could be maintained at several locations.

As mail was received, it was sent to the project survey assistant who opened the envelope and dated the questionnaire in the upper right corner. Then she checked for supplemental enclosures; if any were found, the firm ID number was entered on the enclosed document(s) and these were securely affixed inside the questionnaire booklet. After all mail received during the day was checked in, a scan-edit was conducted (see 5.3.2). Following the scan-edit, the questionnaires were placed in stacks by event code; the event code and date received were entered into the manual log; and then the documents were batched by event code (no more than 50 documents were in each batch). A Batch Header Sheet was completed which listed the ID numbers of all documents contained in the batch and the batch number was entered in the lower right corner of each questionnaire. Any marks made on the questionnaires were in blue-lead pencil.

5.3.2 Scan-Edit Process

The scan-edit checked several "key" items in the questionnaire that determined complete/incomplete and "parent/child" status of the survey data. This status would be the driving factor for assigning event codes for the control system. The event codes were also based on whether the returned questionnaire was received as a result of the first mailing, the second mailing, or other follow-up activities. (The assignment of batch numbers was based on the same criteria.) While this process functioned smoothly, there were problems with the event code status assignments. Originally, when it was decided what would constitute certain statuses,

little was actually known about how firms were organized and functioned. Once questionnaires were received and the event assignments began, RTI realized that some assumptions were erroneous; at this point, certain guidelines for assigning events were modified. For example, RTI did not know the exact business structure for many subsidiary firms. During the early stages of data receipt, some subsidiary firms were assigned full receipt status "on their own right"; later the status change put them into a "child" (or subsidiary of a larger responding firm) status.

5.3.3 Control System Keying

As the status of each questionnaire was determined, the document was ready for event keying. The research assistant accessed the computer by phone line which linked her terminal to the RTI main computer facility. Once access was achieved, she entered the event status followed by all questionnaire ID numbers with that event. While this task was simple in itself, extenuating circumstances caused problems and delays in some of the keying.

First, and beyond the control of survey personnel, a telecommunications problem between the terminal and the main computer created indecipherable entries in some transmissions; as a result some events were not received on schedule. In addition, events "backed up;" that is, the system would not accept some events.

Another type of event keying problem was indirectly caused by a combination of questionnaire wording and respondent misunderstanding of the question intent which resulted in insufficient and/or erroneous responses and improper following of routing patterns. As a result, during the scan-edit, a document could be classified and keyed a certain way, and later, under more intense scrutiny, it would be determined that the status should

change because of some respondent misunderstanding, especially in reporting for multiple locations, subsidiaries, etc. This continued changing of event codes was not anticipated when the system was developed and many problems resulted from the activity.

A great deal of time and effort were expended to see that the manual records were in agreement with the computer records. Many documents were also put in a "holding" position until a final event could be determined. This delayed the generation of true response rates, increased computer costs, and forced the system to be used in a way for which it was not designed; that is, it became a monitoring system rather than a true control system.[1] The system was forced to accept many events that were out of programmed sequence; and in many instances several established back-up controls were negated.

5.3.4 Monitoring Survey Progress

The control system was instrumental in generating response status reports on quick notice, and many of these reports were used in meetings with EPA and Association representatives. Most of the discussions and decisions regarding critical followup methodologies were based on the control system reports. It was through the use of the control system that various response problem areas were identified. Likewise, using the receipt event system, project staff could accurately identify problem cases such as duplicate responses from firms with different names but the same

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[1]FORCE is an acronym for "Field Operations Reporting of Current Events" and was designed to support data receipt efforts by documenting questionnaire receipt and processing statuses, i.e., questionnaire received, questionnaire pass edit/fail edit, questionnaire data entered, etc. NUPAS was originally designed as a simple two round mail survey. Because of the unplanned, yet extensive followup activities employed and complicated eventing guidelines, the system was pressed into a role for which it was not designed.

license number, cases originally identified as partials that became complete, firms that were subsidiaries of larger firms in the sample, etc. Without the use of the control system, resolving these and other problems would have been an almost insurmountable task and would have required more labor and funds.

6. NONRESPONSE FOLLOWUP ACTIVITIES AND REMEDIAL ACTIONS

6.1 Necessity for Followup Activities

The first mailing to sample firms occurred during the week of March 29, 1982; after the majority of questionnaires had been in the field for almost four weeks, only 10.74 percent of the firms had responded. This disappointing response rate fell short of the anticipated 40 percent return which was based on projections from EPA, the trade associations, and project staff. Therefore, extensive followup activities were necessary. This chapter describes the reasoning behind the planned activities and how they were undertaken.

6.2 Response Problems

There were several theories as to why the response rate was below expectations (these were discussed in detail in a Memorandum "For the Record", see Appendix D); they will be generally discussed in the following sections.

6.2.1 Effects of Timing of the Survey

From the first planning meetings with EPA, the trade association representatives stressed the importance of getting the questionnaires in the mail well ahead of the busy spring and summer seasons. When RTI first met with EPA and the association representatives, a 1 March mailout date was stressed as being optimal. As it turned out, because of various delays, the first questionnaire batches were mailed 1 April. In retrospect, the most reasonable date for questionnaire mailings would have been in early January. Firms would have received the questionnaire before their busy business season as well as before tax preparation deadlines. Had RTI become involved in NUPAS at an earlier date, this schedule might have been possible.

Also, there were many small firms in the sample. It should be clearly understood that every firm's business activities during this busy season are critical to their success and financial well-being. The proprietors of such firms probably clearly felt their business activities were of higher priority than completion of the survey questionnaire.

6.2.2 Identifying the Correct Respondent in a Firm

Because of the volume of unwanted or "junk" mail that is probably received by firms, the NUPAS questionnaire could easily have been identified as junk and discarded by a secretary, office manager, or mail handler before the questionnaire was seen by the individual who could respond to the survey. Since the lists of state certified applicators that RTI received in most cases did not contain the name of an individual at the firm, the mailing envelopes were addressed to the firm; RTI felt this uniform treatment of addressing envelopes was preferable and less time consuming than handling firms on an individual basis depending upon whether or not an individual's name was present. It should be noted that names could probably have been secured for the other cases; however, RTI felt this would have caused further delays in the conduct of the survey and resulted in greater expenditures which were already running much higher than planned.

6.2.3 Firms with Multiple Locations

Many sample firms maintained business operations in several cities, across state lines, or at several locations within the same city. Cases where these situations occurred created two-fold problems for NUPAS. First, there was the problem of multiplicity with sample selection that could cause duplicate burden and second, there was a problem on the part of the respondent in knowing exactly how to answer the questions posed in the survey questionnaire. All these problems are discussed below.

When firms maintained operations at several locations, RTI first had to develop ways of identifying such situations; this cleaning operation is discussed in detail in Chapter 2. Compounding the sample selection problem created by this situation, the questionnaire development team had to take into consideration question wording when handling firms with multiple locations. While information was needed at the firm level, RTI had to attempt to make sure that respondents were providing answers collectively for all business locations operating within the reference state under the business name shown on the questionnaire label. Therefore, the definition of "firm" became crucial in terms of the respondents' knowing how to answer certain questions. Because the survey required collective information from all firm locations, the respondent burden was greater for some respondents and this (primarily because of the time involved) probably resulted in a lower response rate.

6.3 Followup Activities Undertaken

The following sections present the various followup activities undertaken by RTI in an attempt to improve the response rate. These activities were begun after several meetings had taken place among RTI, EPA, and the trade associations.

6.3.1 The AAPCO Letter

The AAPCO representative to the NUPAS Committee volunteered to spearhead a followup activity directed at AAPCO members in the sample. A letter was sent to each state AAPCO official asking him/her to furnish RTI a blank piece of letterhead stationery, signature, and an agreement for RTI to reproduce a letter on the stationery (under his/her signature) which would be sent to all nonrespondents licensed in his/her state.

Unfortunately, only 32 AAPCO officials granted permission leaving 24 states without this form of local prompting. Letters were mailed to firms represented by these 32 officials. Officials from the remaining 24 states were contacted by telephone in an effort to solicit their cooperation. Only one such official agreed to grant permission to use the letterhead/signature (specifically, Texas). Nonresponding firms in Texas were sent the AAPCO letter in early August, 1982. The failure to secure the unanimous support of the state AAPCO officials undoubtedly had a major negative impact on NUPAS.

6.3.2 Thank You/Reminder Postcards

Since the result of earlier prompting efforts was somewhat disappointing, RTI began to consider other methods that would possibly stimulate response. Another procedure (somewhat standard for mail surveys conducted by RTI) was the use of a Thank You/Reminder postcard. Such a card serves two purposes--first, it thanks all persons/firms that have taken the time to respond, and second, it acts as a reminder for those who have not.

Since the number of nonresponding firms at the time of the planned postcard mailing was large, RTI felt it would be more economical to use a continuous-feed computer postcard form so that the names and addresses of firms could be printed directly on the card from the master sample tape. However, this required that certain printing stipulations be met--there were limitations placed on the number of printed lines that could appear in the postcard message area, the return address space was limited since there was strict space allocations for printing the firm name and address, etc. The postcards were sent from RTI by 23 June 1982.

6.3.3 Second Questionnaire Mailing

Under normal RTI mail survey procedures, a second questionnaire mailing would occur generally four weeks after the first mailing. RTI planned

a second mailing for NUPAS, but understandably, did not anticipate that the effort would be of the magnitude realized. In hopes that more firms would respond to earlier promptings, the decision was made to delay the second questionnaire mailing for several weeks. This delay would give nonresponding firms time to complete the questionnaire and get it in to RTI before the mailing cut-off date, thereby reducing the number of firms in the second mailing. Likewise, this would reduce costs for direct labor in preparing the mailout, computer time for printing the necessary labels, and postage for mailing. Printing charges for cover letters (which had to be revised) and other incidental costs would be less, as well. The second questionnaire mailing took place during the first week of July, 1982.

6.3.4 Other RTI and Trade Association Followup Activities

Again, following standard RTI survey procedures, all nonrespondents to earlier followup activities were telephone by trained and experienced telephone interviewers during the first two weeks of August, 1982. The interviewers stressed the importance of the survey and encouraged the firm representative to complete the questionnaire as soon as possible and return it to RTI.

The trade associations were eager to offer additional assistance that might increase response. Representatives once again telephoned state lead agencies and local officials within their respective organizations and encouraged response.

The response rate for sampled locations for three major pest control firms--Orkin, Chemlawn/Chemscape, and Terminix--was extremely low. Because these firms, by virtue of their subsidiary structure, represented such a large portion of the pest control industry, their participation was considered critical if representative estimates of pesticide usage were to

be generated. For this reason, the national headquarters of each of these firms was contacted and asked to furnish data for their entire operations. Each organization complied with RTI's request for national data, allowing a portion of the original sample to be treated as a census. This enhanced the response rate by converting many of the subsidiary establishments of these firms who had not responded to the completed category. However, because the data had to be weighted accordingly for this group, the level of weighting complexity was dramatically increased.

It should be noted that there were differing opinions as to the effect of continued followup activities. On the one hand, from the efforts expended respondents could certainly see that EPA, RTI, and the trade associations were convinced of the importance of NUPAS. On the other hand, the sample firms could just as likely become so "over-saturated" with survey materials and repeated requests to cooperate that they would become more determined not to reply. It was unknown which would occur.

6.4 American Association of Retired Persons Interviews

6.4.1 Perceived Need for Interviews

As of 31 July 1982, the number of nonresponding sample members was 5,790 out of the 8,779 selected (see Table 6-1). The magnitude of the nonresponse problem resulted in another followup activity, that being a personal visit to the nonresponding firms by field staff employed by the American Association of Retired Persons (AARP). In addition, AARP field staff would call upon a sample of firms who had completed a questionnaire but failed to furnish quantitative pesticide usage data (103 out of 412 as of 31 July 1982). After meetings were held, a final sample of 1,320 firms was selected for the AARP field effort.

Table 6-1. Event Status Codes as of July 31, 1982

Event Status Code (x=1 or 2)	Description	Number of NUPAS Sample Members		
		Wave 1	Wave 2	Overall
90	Sampled, not mailed	59	-	59
x00	In the field	0	5790	5790
x02	Undeliverable	274	0	274
x03	Out of business	10	46	56
x04	Refused	6	21	27
x06	Ineligible	208	285	493
x08	Partial respondent	190	234	424
x09	Partial respondent (branch)	2	7	9
x10	Complete	680	954	1,634
x11	Complete (branch)	3	10	13
		1,432	7,347	8,779

6.4.2 Anticipated Results of Interviews

It was hoped that the results of the AARP effort would have a positive effect on the general success of NUPAS. First, it was anticipated that through the use of a personal interviewer, the nonrespondents would further see the importance of the survey and agree to cooperate. Also, problem cases identified during the central office edit of questionnaires could be resolved. In addition, cases identified as undeliverable in the second mailing could be assigned to the field effort in hopes of either (1) verifying the firm's status or, (2) locating the firm so further action could be taken. Because of time and budget constraints, the undeliverable cases were not verified.

RTI voiced some reservations to using the relatively inexperienced AARP field staff for such a large and difficult activity. Some of these reservations were lessened when a decision was made to supplement the AARP field staff with experienced RTI field interviewers, primarily in areas where AARP could not furnish coverage.

6.4.3 Preparation of Materials and Training of Staff

In August 1982, RTI project staff met in Washington with the EPA Project Officer and the AARP Field Coordinator for Special Projects. During this meeting, discussions were held on training in general and the training manual in specific. Upon arrival at RTI a rough draft of the training manual was prepared by RTI and was given to the AARP Coordinator to prepare for the training of AARP regional supervisors.

The decision was made to conduct a personal training session for the AARP regional supervisors who would in turn conduct telephone training sessions with the interviewers in their respective regions. This regional telephone training would follow interviewer receipt by mail of the training

manual and other survey materials prepared jointly by RTI and AARP. RTI reproduced the training manuals and delivered them to AARP for distribution to the field staff.

A one-day training session was held at RTI for AARP regional supervisors; the session was jointly conducted by representatives of RTI and AARP. The EPA Project Officer was in attendance to furnish logistical assistance as needed. The FORCE system was used to furnish questionnaire labels, up-dated status reports on sample cases, etc.

Following completion of the RTI training session, the AARP regional supervisors returned to their areas and conducted the telephone training of field interviewers. This effort was monitored by the AARP Field Coordinator who regularly kept RTI informed of progress via telephone.

6.4.4 Data Collection

Data collection from the personal followup was disappointing. Many problems resulted from confusion surrounding the field assignments, inefficiencies and delays in enumerator hiring, delays in completing assignments, etc.

Field assignments were initially based on a probability sample of 1,320 firms selected from the frame defined as of 31 July 1982. Special treatment was to be afforded sample members previously submitting partial information (identified by an asterisk on the field assignment lists), sample members who were subsequently determined to have been undeliverable after 31 July, sample members who later submitted a completed questionnaire or were deemed ineligible on a questionnaire submitted after 31 July (both of which were to be purged from the sample), and firms operating under the names ChemLawn, Orkin or Terminix (which were to be purged). These activities were carried out manually by the AARP Field Coordinator and the EPA

Project Officer on 12 August under extreme time pressures. Understandably, some minor omissions were later uncovered. Furthermore, based on RTI site visits to Terminix, five locations previously purged had to be re-activated in the sample due to being franchises (the potential for same was recognized at the outset). Finally, field assignments were continually updated based on returned questionnaires. It is not surprising that there was strong potential for confusion in the field concerning which firms were to be enumerated and how partial/undeliverables were to be differentially treated.

For planning purposes, it was assumed that a typical AARP enumerator working a 20 hour 5-day week could handle at most one firm per calendar day. As such, if 1,200 of the original 1,320 sample firms were to be contacted, a field staff of at least 40 interviewers would be required to meet the desired completion date. Moreover, the dispersed nature of the NUPAS sample further aggravated the workload situation. As it turned out, AARP had not hired enough persons to complete the work within schedule. Delays in data collection escalated costs and the inability of AARP to furnish adequate coverage of the probability subsample further affected the data quality.

6.4.5 Data Receipt and Review of AARP Materials

RTI began receiving completed materials from the AARP field staff during September, 1982. Upon receipt, these documents were scan-edited by project staff to ensure that the minimum required data elements had been secured, or reasons furnished by the field staff for not having done so. Questionnaires found to be deficient in either of these regards were event-keyed as such and returned to the AARP Field Coordinator. The experience from this effort showed that the quality of returns from the field varied

greatly. This was due, in part, to difficulties associated with training enumerators by mail and perhaps to the size of the AARP regional supervisor workloads which prevented the exercise of adequate quality controls.

The AARP Field Coordinator responded to the problems discovered and was in continual contact with the regional supervisors. They discussed any problem areas with the enumerators under their supervision.

6.4.6 Debriefing for Field Effort

On 16 November 1982, the RTI Project Director attended and conducted a debriefing during which the AARP field effort was critiqued. During this session, it was hoped that insight would be gained from the regional supervisors concerning problem cases, feedback would be provided from RTI on the effort, gain information that would help assess data quality, and discussions would be held on ways of improving the quality and/or manageability of future joint data collection efforts.

The discussions revealed that major problems occurred because the field staff, in many cases, attempted to conduct the follow-up by telephone -- which gave rise to a high number of refusals and incompletes. In addition, the field staff was unprepared to deal with numerous field situations because of inexperience and insufficient training.

7. SURVEY STATUS AS OF OCTOBER 31, 1982

By late October, only a few questionnaires per week were being received by AARP enumerators or "spontaneous" respondents. A decision was made to officially terminate data collection on October 31, 1982. The final status of all sample members on that date is given in Table 7-1. Data on questionnaires returned after October 31, 1982 were not included in an analyses, unless the response had been specifically solicited by RTI.

Prior to termination of data collection, work began on editing and processing the data received from respondents. Data processing and editing, as well as weighting and preliminary analysis activities, are discussed in Technical Volume II of this report.

Table 7-1 Final Event Status Codes of NUPAS Sample Members

Event Status Code (x=1, 2, or 3)	Description	Number of NUPAS Sample Members			
		Wave 1	Wave 2	AARP	Overall
90	Sampled, not mailed	59	-	-	59
x00	In the field	0	4,084	43	4,127
x01	Received by AARP	0	0	12	12
x02	Undeliverable/ unable to contact	274	114	189	577
x03	Out of business	10	54	45	109
x04	Refused	6	26	404	436
x06	Ineligible	211	333	75	619
x08	Partial respondent	136	228	102	466
x09	Partial respondent (branch)	2	10	9	21
x10	Complete	681	1,344	301	2,326
x11	Complete (branch)	3	16	8	27
		1,382	6,209	1,188	8,779

APPENDIX A

Documentation of the Survey Design for the Seven Telephone States

RESEARCH TRIANGLE INSTITUTE

July 25, 1983

RTI/2517/01F

Documentation of Sample Design, Selection and Weighting in the Seven Telephone States of the National Urban Pesticide Applicator Survey

by

Lanny L. Piper
Vincent G. Iannacchione
Douglas J. Drummond

Research Triangle Institute
Research Triangle Park, NC 27709

Purchase Order No. 2W-4924-NTSX

Project Officer: Linda E. Zarow

Economic Analysis Branch
Benefits and Field Studies Division
Office of Pesticide Programs
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460

A-1.a

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1. INTRODUCTION

The U.S. Environmental Protection Agency (EPA) has a need for accurate quantitative usage data on pesticides applied by professional applicators in the urban/nonfarm sectors of the U.S. These data are needed as inputs to EPA pesticide regulatory and research programs and are useful to other agencies, states, and the general public. To address this need, EPA conducted the National Urban Pesticide Applicator Survey (NUPAS) as part of Contract 68-01-5848.

The classification of professional applicators is generally categorized by the sites being treated. The pest control operator (PCO) is oriented toward urban or household and structural pest control problems. Other major professional applicators include those who serve the agricultural market and the industrial applicators who serve a wide assortment of markets. The industrial applicators are frequently divided into smaller categories to include arbor pest control, industrial weed control, etc.

The NUPAS sampling frame was constructed using state licensing lists for commercial pesticide applicators. Three categories of lists existed: (1) states licensing firms; (2) states licensing individuals but having a firm name identified on their lists; and (3) states licensing individuals but having no visible reference to an associated firm. The NUPAS design then selected from the lists a sample of firms in category 1 and 2 states, and a two-phase selection process was applied for category 3 states. A description of the list sample is provided in another document. This document deals solely with the two-phase sample.

survey questionnaire may easily have been identified as such and discarded by an overzealous secretary or primary mail handler without ever being seen by an individual who could respond to the questions. All envelopes were addressed to the firm rather than an individual in the firm. RTI had names within organizations for many cases but felt that uniform treatment of cases across the sample was preferable. Names could possibly have been secured for the remaining cases; however, this would have further delayed the first mailing and added to the expenditures.

- Getting the questionnaire to the person who can best answer the questions -- While this would probably not be a problem in the smaller firms with only a few employees, the larger firms may not be able to readily identify the most appropriate person to answer the survey questions. In addition, in very large firms, more than one person might be needed to answer certain questions, thus slowing the response process or convincing them that the survey was not worth the effort.

Specifically, telephone interviewers were able to secure a telephone number from Directory Assistance for only 62% of the Phase I sample members (i.e., licensed applicators). This may be due to having a faulty address (e.g., for business as opposed to residence) or simply due to a recent move. Once the number was secured, however, telephone screening was successful in 77% of the cases (see Exhibit A).

Current plans call for a second mailing to all nonresponding firms; it should be noted that this mailing for the first 42 states has already been delayed one week in hopes that more questionnaires would be received, thereby reducing the number to be mailed in the second wave.

2. SAMPLE DESIGN FOR THE TELEPHONE SURVEY OF LICENSED APPLICATORS

2.1 Target Population

The first phase of the sample design required a telephone screening of a sample of licensed applicators in each of the seven states identified as category 3 states, i.e., where the state licensing procedures identified only applicators and not the firms they were employed by. The target population of the phase one sample was all persons licensed in one of the seven states who were currently employed by an eligible firm. To be eligible a firm had to provide pest control services on a commercial basis (i.e., for a fee) in at least one of the following areas: lawn, tree, or structural.

2.2 Sampling Frame Construction

The seven states were in this telephone screening portion of NUPAS because the regulating state agency could not provide RTI with a list of businesses that operated in the state to apply pesticides on a commercial basis. Thus, a surrogate unit had to be identified that could best direct our efforts to identifying the operating commercial pesticide applicator businesses in each state. The surrogate that appeared to best suit the needs and constraints of the survey was a list of persons licensed by the state to apply pesticides in the areas of interest (i.e., tree, lawn and structural). Inquiries were made to each of the seven states' Departments of Agriculture to determine the source for such lists. Requests for the lists were then made by the Association of American Pesticide Control Officials (AAPCO) to the designated agency in each state. In some cases this procedure was complicated when multiple departments had to be contacted to obtain a complete listing.

2.2.1 Source

The following table presents the agency that provided the list of pesticide applicators in the specified state.

State	Agency That Provided Listing
Arizona	State of Arizona Structural Pest Control Board
Louisiana	Department of Agriculture, Office of Agriculture and Environmental Sciences
Massachusetts	Department of Food and Agriculture Pesticide Board
Nebraska	Nebraska Air and Waste Compliance Branch, Region VII
Pennsylvania	Pennsylvania Department of Agriculture, Bureau of Plant Industry
Virginia	Virginia Department of Agriculture and Consumer Services
West Virginia	Department of Agriculture, Pesticide Use and Application Plant Pest Control Division

2.2.2 Data Contained in the Frame

Since there are no federal guidelines for maintaining standard information on pesticide applicators, each state has a different set of data it maintains and its own format for reporting the data. Every list had the person's name, address, and the state's indicator of the type of applicator. It was unknown whether the address listed was the person's home or business address. Also in many states the type of applicator codes did not conform to the federal codes (i.e., category 3A, 3B, and 7). This required additional work to map the state codes into the corresponding federal codes. The following table shows the data items contained on each state's listing.

State	Data Items on Listing
Arizona	Name of applicator, address, application category
Louisiana	List 1: Name of applicator, address, application category List 2: Business name, address, telephone number, application category
Massachusetts (file was only 95 percent complete)	Name of applicator, address, license number (application category was obtained by RTI staff member visit to the agency who manually recorded it on the listing)
Nebraska	Name of applicator, address, telephone number, application category, applicator type (e.g., commercial), reciprocal information, personal data (e.g., height, weight, birthdate), commercial examinations, commercial reciprocals
Pennsylvania	Name of applicator, address, application category
Virginia	Name of applicator, address, applicator category, permit number, social security number, date permit issued, permit expiration date, certification expiration date, fee status, reciprocal agreement status
West Virginia	Name of supervisor,[1/] address, applicator category

[1/] West Virginia provided a list of supervisors of companies licensed to apply pesticide. No definition of "supervisor" was given.

The states provided the most current data available which turned out to be for 1981. When the data was received at RTI, numerous calls had to be made to some of the states to interpret their data. In one case, for the state of Massachusetts, an RTI staff member made a personal visit to the cooperating agency to obtain information that would allow the listed licensees to be assigned an applicator category. In the states of Virginia, Massachusetts, Nebraska, and Arizona the applicator codes did not correspond to the EPA codes and the codes were manually converted for each person on the list to conform to the EPA codes.

2.2.3 Initial Elimination of Ineligibles and Duplicates

Listed individuals that were not licensed in either of EPA code 3 or code 7 (or state equivalents) were eliminated from the sampling frame. When the code 3 licensees were listed separately from the code 7 licensees, the two lists were cross-checked for duplicates. When a duplicate was identified, one of the listings was eliminated and the remaining listing was corrected to show that the individual was licensed in both categories 3 and 7. No attempt was made to cross-check listings in other states to identify duplicates across states.

2.2.4 Stratification

The frame for each state was stratified by the two applicator categories, code 3 and code 7. Three strata were defined using these codes. There was a stratum for individuals categorized as code 3 and not code 7, a stratum for those categorized as code 7 and not code 3, and a stratum for those categorized as both code 3 and code 7. As will be discussed in the next section, the members of the stratum containing licensees with both code 3 and code 7 were allocated to one or both of the other two strata before the sample was selected.

2.3 Sample Selection

2.3.1 Desired Results

The development of the sample design for the seven states included in the telephone screening portion of NUPAS was driven by the desire to achieve the same precision of estimates for these seven states as expected in the other states in NUPAS. This consideration led to the sample design decision to attempt to obtain 75 "structural" applicator businesses and 75 ornamental and turf applicator businesses in each of the seven states. This would then allow computation of estimates of the total number of businesses in each

category in each state. Sampling rates used in the "mail-only" portion of NUPAS could then be applied to these estimated totals and a sample size determined for each state.

2.3.2 Assumptions

Many important items of information regarding the frames of licensed applicators obtained from each state were unknown. Such unknowns included:

- the proportion of the licensees working for a busines that did not contract their service for a fee;
- the proportion of the licensees no longer working as an applicator (remember the lists of licensees were 1981 lists);
- the average number of licensed applicators employed by commercial applicator businesses in 1981;
- the proportion of licensees who had no phone or an unlisted number.

Because this information was not available and was not readily obtainable, certain assumptions were made. It was assumed that, on the average, for every two licensees called, one business would be identified. This two-to-one ratio was to account for the unknowns listed above plus nonresponse. Since the desired number of businesses in each of the two categories was 75, this assumption required that 150 licensees be selected from each of the two categories.

A constraint was imposed on the sample selection in order to have some control over the variability of sampling weights. For each state, within an applicator category, a maximum of 60 percent of the licensees listed on the frame was selected in the sample. The only exception to this constraint was for the state of West Virginia which had such a few number of licensees on its frame that all were included in the telephone screening sample.

Since the reliability of the assumption was very questionable, it was decided to select twice as many licensees as assumed were needed in each category. Therefore, 300 licensees in each category in each state were selected. The sample was then given to the telephone interviewers in waves of 100 licensees from each applicator category in each state. The results from each set of 100 sample licensees was monitored and additional waves of 100 were assigned as needed. In the ornamental and turf category in all states the maximum sample of 300 or 60 percent of the total number in the category, was eventually assigned to be interviewed. In the structural category the minimum of either 200 or 60 percent of the total number in the category was assigned for interviewing.

2.3.3 Procedures

As discussed above, the listings in each state were stratified into three strata; ornamental and turf applicators, structural applicators, and both ornamental and turf and structural applicators. Before the sample was selected, the listings in the stratum having licensees identified as both ornamental and turf and structural applicators were reallocated to one of the other two strata. In most cases the allocation was proportional to the number of listings in each of the two strata. However, in cases where one stratum had fewer than 300 listings and the other stratum had over 300, then the "both" stratum was allocated to the smaller stratum. Figure 1 shows the number of listings in each stratum by state. Figure 2 shows the number of listings in the two sampled strata by state after reallocating the listings in the "both" stratum.

The sample was then selected by state within stratum with equal probabilities and without replacement. This was accomplished by generating a random permutation of the numbers 1 through N_{hi}, (N_{hi} = the number of listings

FIGURE 1

Number of Listings in the Sampling Frame
for Each State by Stratum

State	Ornamental and Turf	Structural	Both
Arizona	68	918	174
Louisiana	186	162	1
Massachusetts	751	432	51
Nebraska	631	173	23
Pennsylvania	762	856	67
Virginia	665	697	138
West Virginia	19	121	7

FIGURE 2

Number of Listings in the Sampled Strata
and the Sample Number of Listings Selected by State

State	Ornamental and Turf		Structural	
	Total	Sample	Total	Sample
Arizona	242	145	918	200
Louisiana	187	112	162	54
Massachusetts	783	300	451	200
Nebraska	631	300	196	100
Pennsylvania	794	300	891	200
Virginia	732	299	768	201
West Virginia	19	19	128	128

in a stratum - h and state - i). The first nhi (n_{hi} = sample size) numbers identified the sample. The frame had been previously ordered and each licensee listed was assigned a number from 1 to N_{hi}. The sample licensees corresponded to the first n_{hi} numbers in the generated permutation.

3. DATA COLLECTION -- TELEPHONE

3.1 Questionnaire Design

The main objective of this screening operation was to identify the name and address of the firm or firms that employed the licensee as a pesticide applicator. The questionnaire used is shown in Figure 3. Auxiliary information was also obtained as a result of questions used to clarify our definitions of working as a pesticide applicator and of the type of business of interest. Additional questions were also used to prompt the respondent to consider all possible types of businesses he may be working for and not just the most obvious or the one from which the majority of his income was obtained. The final question was included so that the businesses could be stratified before the final phase of sampling.

3.2 Preparation of Materials

After having finalized the questionnaire and obtaining the required number of reproductions, the identification information in Section A of the questionnaire (see Figure 3) was completed using the sampling frame information. Of the seven states included in this telephone screening, only Nebraska's frame listed the licensee's telephone number. In the other states, a call to Directory Assistance was required to attempt to complete the "Telephone" item of Section A of the questionnaire. A unique seven-digit identification number was assigned to each sample licensee. This ID was composed of the following:

Figure 3

NATIONAL URBAN PESTICIDE APPLICATORS SURVEY

Telephone Questionnaire

A. IDENTIFICATION

Name: _____ ID: _____

Address: _____

City: _____ State: _____ ZIP: _____

Telephone: (_____) _____ - _____ State Issuing License: _____
(Area Code)

B. RECORD OF CALLS

Int.	Date	Time	Result	Result Code
		am/pm		
		am/pm		
		am/pm		
		am/pm		
		am/pm		

RESULT CODES:

11 = Nonworking [AFTER 2 CALLS, CODE FINAL]
12 = Temporarily nonworking [AFTER 3 CALLS, CODE FINAL]
13 = Double wrong connection
14 = No result from dial [AFTER 3 CALLS, CODE FINAL]
15 = Fast busy signal [AFTER 3 CALLS, CODE FINAL]
16 = Regular busy signal [TEMPORARY CODE ONLY]
17 = Ring, no answer [AFTER 3 CALLS, CODE FINAL]
18 = Wrong number [TEMPORARY CODE ONLY]
19 = Person not living at given number
20 = Deceased
21 = Person not there, call back later
30 = Refusal before eligibility established
31 = Refused Section D
32 = Business number with no such employee
33 = No listing from Directory Assistance
35 = Other (SPECIFY) _____
_____
40 = Complete

C. TELEPHONE VERIFICATION

1. Hello, I am _____ from the Research Triangle Institute in North Carolina. We are conducting a national survey of pesticide applicators. May I please speak with (NAME)?

Yes . . . . . (GO TO SECTION D)

No. . . . . } (TALK WITH SPOUSE OR OTHER ADULT)
Not home. . . . . }

Doesn't live here . . . . . { (ATTEMPT TO GET PHONE NUMBER OR ADDRESS. IF UNSUCCESSFUL CODE 19 AND TRY DIRECTORY ASSISTANCE IF APPLICABLE.)

Deceased. . . . . (CODE 20)

Don't know person . . . . . (GO TO QUESTION 2)

Business number, person employed but not there. . . (ASK FOR A CALLBACK TIME)

Business number, person not employed. . . . . { (CODE 32 AND ASK IF THE RESPONDENT KNOWS HOW THE PERSON MIGHT BE CONTACTED)

Other . . . . . (SPECIFY_____)

2. Is this number (PHONE NUMBER)?

Yes. . . . . (CONFIRM THAT THE RESPONDENT DOES NOT KNOW THE SAMPLE PERSON AND END CALL)

No . . . . . { (ASK FOR CORRECT NUMBER AND RECORD HERE: (_____) _____ - _____. TERMINATE INTERVIEW AND REDIAL ASSIGNED NUMBER. IF SAME WRONG NUMBER IS REACHED, TERMINATE AND CODE 13.)

Digit	Definition
1	Census Division identified (codes 1-9)
2-3	Census defined state code
4	Stratum identifier 1 = code 3 licensee 2 = code 7 licensee 3 = code 3 and code 7 licensee allocated with code 3 stratum 4 = code 3 and code 7 licensee allocated with code 7 stratum
5-7	Sequential number assigned to the licensee in the frame listing

Before the questionnaires were given to the telephone interviewers, the ID numbers were recorded on an assignment log. When the questionnaire was returned after completion of the case, the date was recorded on the assignment log.

3.3 Telephone Survey Operations

3.3.1 Training

A technique used to improve the quality of data collected in any survey is to conduct a training session with the interviewers. A two-hour training session was conducted with the interviewers for the telephone screening task of NUPAS. The training session provided background information about the study including its purpose and objectives, sponsors and what had already been done on the project. The interviewers were also told the source of the names, addresses and phone numbers of the persons they would be calling. This information provided the interviewers with a base of knowledge that could be used in responding to questions and concerns a respondent might have.

The interviewers were also trained on the procedures to complete each section of the questionnaire. Each item on the questionnaire was discussed in as much detail as necessary. Included as topics of discussion were the purpose of the item, definition of terms, proper procedure to record the

D. QUESTIONNAIRE

INTRODUCTION: I have just six questions to ask. The purpose of the study is to develop data on pesticide usage and the number and size of businesses engaged in pesticide application. Your answers will assist us in identifying such businesses.

1. (Do you/Does [PERSON]) work either full-time or part-time as an applicator of pesticides?

   Yes. . . . . (CONTINUE)

   No . . . . . (THANK RESPONDENT AND END INTERVIEW)

2. (Do you/Does [PERSON]) work for a business that furnishes pest control services on a commercial basis, that is, for a fee?

   Yes. . . . . (CONTINUE)

   No . . . . . (THANK RESPONDENT AND END INTERVIEW)

3. (Are you/Is [PERSON]) self-employed, a partner, or an employee of such a pest control business?

   Self-employed. . . . .
   Partner. . . . . } (CONTINUE)
   Other. . . . . .

4. What is the complete name of the pest control business or businesses that you are now working for?

   a. _____

   b. _____

   c. _____

5. What is the complete address of (BUSINESS NAME)?

   a. _____

   b. _____

   c. _____

6. Which of the following types of applications does (BUSINESS) contract for?

	BUSINESS
Lawn and Turf.	a . . . b . . . c
Tree, Shrub, and Ornamental.	a . . . b . . . c
Other (e.g., termites and other wood destroyers, commodity fumigations, etc.) . . .	a . . . b . . . c

Thank you for your cooperation and assistance in this research study. The businesses we have discussed may be selected to receive a questionnaire by mail in the near future. You can be assured that your name will not be mentioned when contacting the businesses. Again, thank you for your help.

STOP

response, and potential problems and their resolution. Questions from the trainees were also entertained and answered.

3.3.2 Directory Assistance

The only state whose listing included the licensee's phone number was Nebraska. In the other six states it was necessary to call Directory Assistance to attempt to obtain a telephone number for the licensee. There were some problems obtaining a phone number from Directory Assistance. Since the lists were from 1981, there were some persons who had moved since the listing had been compiled and the address on the listing was out of date. A second problem was that it was unknown if the address given was the licensee's home address or business address. If it happened to be the business address, then Directory Assistance would have no telephone listing for the person at that address. There was also the problem of persons having unlisted numbers. All told, no telephone listing could be obtained from Directory Assistance for 28 percent of the sample licensees in the seven states. As a quality control measure to assess the bias in the screening data resulting from the inability to obtain a telephone number for more than one fourth of the sample, the screening questionnaire was mailed to all such sample licensees.

3.3.3 Administering the Questionnaire

The questionnaires were administered by telephone interviewers in RTI's Telephone Survey Unit over a period of approximately three weeks. When an interviewer made a contact, their first responsibility was to verify they had reached the household or employer of the sample licensee. Having verified this, the interviewer would ask to speak with the named sample licensee. If that person was not there, the interviewer would then ask to speak with the licensee's spouse, or another adult member of the household, in that order. The decision to allow proxy respondents was predicated on three reasons.

First was the cost and schedule issue. Requiring the named licensee to be the respondent would have necessitated additional callbacks. This would have extended the time period needed to complete the requisite number of questionnaires, and additional interviewer hours and telephone tolls would have been incurred. The second reason was concern about the response rate. Experience has shown that the response rate decreases if callbacks to a household are required to obtain a specific respondent after the household has been contacted initially. The third reason was that the data being collected was very general in nature and it was felt that the expert knowledge of the licensee was not required.

3.3.4 Problems Encountered

The main problem was obtaining telephone numbers from Directory Assistance, as discussed previously, stemming from outdated addresses and/or addresses that were business addresses instead of home addresses. Another problem that occurred, primarily in the ornamental and turf category but also existed in the structural category, was licensees working for a business that did not commercially contract the applicator's services. Such businesses were golf courses, city and state parks, schools, bakeries, and others. Use of proxy respondents also created problems with the data quality. The major problems was the proxy not knowing the business firm's address and often not even knowing the street where the business was located. The proxy many times was unable to provide the full business name and would give only the local name. This caused problems identifying duplicate businesses during the mailout, so that more than one questionnaire would not be sent to the same business. Whenever a proxy was unable to provide all the information necessary for the mailout, callback requests were made for a time when the named licensee would be home to be interviewed. A problem that occurred just once was a

small business that had most of its employees selected in the sample. The employees told the owner of the business who became disturbed by the number of calls. The owner then contacted the representative of his business' trade organization to complain about the number of calls his employees had received.

3.4 Analyzing the Data

Businesses identified on the completed questionnaires were listed separately according to the combination of responses to Question 6, i.e. the type of application contracted for, and by which of the seven states the questionnaire was associated with. This defined eight groupings of businesses within the seven sample states. After all completed questionnaires had been received from the businesses and compiled in the above-designated fashion, the groupings were collapsed into three categories before sampling allocations were computed. The three categories were:

1. Lawn and Turf and/or Tree, Shrub, and Ornamental;
2. Termites and Other Wood Destroyers, Commodity Fumigations, General Pest Control, and Other; and
3. Both 1. and 2. above.

Overlaying the two strata of the sample design on the three categories of business identified after completing the screening defined six strata. This 2 x 3 table in each of the seven sample states classified the businesses by the expected type of applications crossed with the licensees' reported classification of the businesses' type of applications. This was used as the bases for allocation of the sample of pesticide applicator businesses in the seven states.

4. SAMPLE DESIGN FOR THE MAIL SURVEY OF PEST CONTROL BUSINESSES

4.1 Target Population

The telephone screening operation discussed previously was the first phase of a two-phase sample that identified businesses that offered pest control services on a commercial basis. The second phase was a sample of the eligible pest control businesses identified in phase one. The target population for the second phase sample was the same as the target population for the 42 category 1 and 2 states of NUPAS, i.e. businesses that offered pest control services on a commercial basis during 1981 in at least one of the following areas: tree, lawn and structural.

4.2 Effective Population

The target population is the population the survey desires to obtain information from and to make inferences about. The effective population, on the other hand, is the population from which the sample was selected and about which inferences from the sample data pertain. For this second phase sample the effective population can be defined as that part of the target population that is covered due to restrictions in the sample design. In this case, the construction of the sampling frame of businesses in the target population was restricted by the need to screen by telephone a sample of licensed pesticide applicators to identify the business name and address of all commercial pest control businesses for whom the sample individual worked. Thus the effective population is the set of businesses that would be identified through the telephone screening procedure described in Chapters 2 and 3. If all licensed applicators identified by a state and determined to have a license issued in one of the areas of interest to NUPAS were screened, the resultant list of businesses may represent the entire target population of the state, but in all likelihood it would be a subset of the target population.

4.3 Sampling Frame

The sampling frame for the second phase of the design was constructed from the responses obtained in the first phase screening. The data from individuals who, in the first phase screening, responded that they were employed as a pesticide applicator for a commercial pest control business and who identified the business were used in constructing the sampling frame for the second phase sample. All reported eligible businesses were included in the frame, and they were included as many times as they were reported. Thus, multiplicities were intentionally introduced into the sampling frame.

The frame was then stratified by two variables. The first stratification variable was a two-level variable taken from the first phase sample. This variable identified the frame business category, i.e. category 3 (lawn, turf, tree, etc.) or category 7 (structural), for each business identified in the screening. The other variable was a three-level variable defined the business category as reported in the screening. The three reporting categories were

- lawn, turf, tree, etc.
- structural
- both lawn, turf, tree, etc. and structural.

These two variables therefore identified six strata in the sampling frame.

4.4 Sample Selection

4.4.1 Desired Results

Each state's sample allocation of pesticide applicators was intended to achieve a self-weighting sample of firms having a precision comparable to the "mail-only" portion of NUPAS. With this goal in mind, a state's sample allocation was determined by applying the "mail-only" sampling rate used in its Census Division to the estimated number of unique firms

identified in the telephone screening. Within a state, the six stratum allocations were intended to preserve the distribution of business categories found in the telephone screening.

4.4.2 Procedures

Sample allocations of pesticide applicators were made proportional to a size measure that estimated the total number of unique firms in each stratum. This size measure was calculated by adjusting the number of responding applicators for eligibility, nonresponse, refusal, and multiplicity so that it reflected the number of unique firms. Each of these adjustments are described in turn.

Pesticide applicators were declared eligible if they worked at least part-time for a commercial firm. The total number of eligible applicators on the sampling frame was estimated by applying the proportion of eligible respondents found in the telephone screening to the total number of applicators on the frame.

Differing rates of response between strata affected the distribution of eligible respondents so that it did not reflect its corresponding frame distribution. Therefore, a nonresponse adjustment was made within each stratum by assigning a weight to each eligible respondent.

A small number of eligible applicators responded to the telephone screening but refused to identify the firm(s) they were employed with. An adjustment similar to the one made for nonresponse attempted to account for these refusals.

Pesticide firms may have employed more than one eligible applicator. Therefore, an estimate of the number of eligible applicators per firm was applied to each stratum. Ornamental and turf firms were assumed to employ 1.5 eligible applicators each, while structural firms were assumed to employ 3

eligible applicators each. A firm that belonged to both categories was also assumed to employ 3 applicators. The estimated total number of eligible applicators for each stratum was then divided by this multiplicity factor to yield a size measure of unique pesticide firms.

The actual sample allocation of businesses for the mail survey was selected with probability proportional to this size measure. A controlled selection algorithm developed at RTI (Chromy 1979)[1/] was used to insure that a state's sample size was proportionally allocated to each of its six strata. Independent simple random samples were then used to select applicators within a stratum. The stratum level allocations for each state are summarized in Figure 4.

4.5 Sampling Weights

The basic or raw sampling weights for the telephone states have two components since the sample design was a two-phase design. One component of the weight represents the selection of the licensee for telephone screening from the state listing. The second component represents the selection of licensees who were determined to be eligible in the screener and who identified the business for whom they worked.

Many businesses employ more than one licensed applicator, and thus, such businesses could be identified for the survey as many times as the number of licensed applicators they employ. Since the questionnaire was "business firm" specific, there was no reason to send multiple copies of the questionnaire to a single business. Thus, whenever multiple licensess from the sample firm were selected, only one questionnaire was mailed. This requires that the sampling weight have a multiplicity factor to account for this design feature.

1/ Chromy, James R. (1979). Sequential Sample Selection Methods. American Statistical Association 1979 Proceedings of the Survey Methodology Section.

Figure 4

Sample Allocations for Mail Portion of Survey[1/]

State	Stratum						Overall
	Code 3 License			Code 7 License			
	Ornamental			Ornamental			
	Turf	Structural	Both	Turf	Structural	Both	
Arizona	11(7)	1(0)	4(1)	6(6)	30(27)	16(13)	68(54)
Pennsylvania	56(56)	4(2)	7(4)	2(2)	45(39)	21(18)	135(121)
Virginia	49(45)	5(2)	5(2)	1(1)	50(50)	16(12)	126(112)
Nebraska	57(54)	7(3)	8(3)	0(0)	28(13)	7(3)	107(66)
West Virginia	9(8)	0(0)	0(0)	1(1)	46(23)	7(3)	63(35)
Massachusetts	67(67)	3(1)	14(7)	2(2)	69(36)	18(10)	173(123)
Louisiana[2/]	21(17)	0(0)	2(1)	0(0)	1(1)	0(0)	24(19)
Overall	270(254)	20(8)	40(18)	12(12)	269(189)	85(49)	696(530)

1/ Entries in table are N(n) where N is the number of eligible applicators on the Phase II sampling frame and n is the corresponding sample size.

2/ Does not include a supplemental list sample of 151 mostly structural firms.

For respondents, this multiplicity factor could have been obtained from Question 11 of the NUPAS questionnaire which asks for the number of certified or licensed applicators in the reference state. However, because of several reasons this may not be a very good variable to use in determining the multiplicity factor. Some of the problems include misinterpretation of the question, differentiation of the definitions of "certified" and "licensed" from state to state, the unknown level of reporting aggregation by the respondent, and basic frame problems such as using a 1981 frame and completing the questionnaire in 1982 which allows for changes over time in the number of licensed applicators employed by the firm.

The multiplicity value for the nonrespondents is even a greater mystery. An imputation procedure will be developed for the multiplicity factor of the nonrespondents that exhibits some stability across state and industry categories.

Therefore, the weights for the telephone states will have the following form:

$$W(jim) = \frac{W_I(ji)W_{II}(ji)}{k(jim)}$$

where $W(jim)$ = the sampling weight for firm -m identified by sample individual -i in state -j

$W_I(ji)$ = the phase I sampling weight for individual -i in state -j

$W_{II}(ji)$ = the phase II sampling weight for individual -ji

$k(jim)$ = the multiplicity factor for firm -m identified by individual -ji

Note: The multiplicity factor, k(jim), is constant for a given firm in a state and is not dependent on sample individual -i as may be implied by the notation. This notation is used to show the computational relationship of the multiplicity factor to the weight.

4.6 Summary

The purpose of this report is to document the activities for that component of NUPAS that required initial telephone screening. Detailed information of the final sampling weight computations for the telephone states including multiplicity factors, nonresponse adjustments, and nonresponse subsample follow-up will be included in the documentation for the entire NUPAS sample as part of Work Assignment 4 on EPA Contract No. 68-01-6646. Delays in this report were due to the need to re-contact some of the responding firms to clarify their reporting aggregate, their industry type and their number of certified applicators.

APPENDIX B

Telephone Screening Questionnaire

NATIONAL URBAN PESTICIDE APPLICATORS SURVEY

Telephone Questionnaire

A. IDENTIFICATION

Name: _____ ID: _____

Address: _____

City: _____ State: _____ ZIP: _____

Telephone: (_____) _____ - _____ State Issuing License: _____
(Area Code)

B. RECORD OF CALLS

Int.	Date	Time	Result	Result Code
		am/pm		
		am/pm		
		am/pm		
		am/pm		
		am/pm		

RESULT CODES:

11 = Nonworking [AFTER 2 CALLS, CODE FINAL]
12 = Temporarily nonworking [AFTER 3 CALLS, CODE FINAL]
13 = Double wrong connection
14 = No result from dial [AFTER 3 CALLS, CODE FINAL]
15 = Fast busy signal [AFTER 3 CALLS, CODE FINAL]
16 = Regular busy signal [TEMPORARY CODE ONLY]
17 = Ring, no answer [AFTER 3 CALLS, CODE FINAL]
18 = Wrong number [TEMPORARY CODE ONLY]
19 = Person not living at given number
20 = Deceased
21 = Person not there, call back later
30 = Refusal before eligibility established
31 = Refused Section D
32 = Business number with no such employee
33 = No listing from Directory Assistance
35 = Other (SPECIFY) _____
_____
40 = Complete

C. TELEPHONE VERIFICATION

1. Hello, I am _____ from the Research Triangle Institute in North Carolina. We are conducting a national survey of pesticide applicators. May I please speak with (NAME)?

Yes . . . . . (GO TO SECTION D)

No. . . . . }
Not home. . . . . } (TALK WITH SPOUSE OR OTHER ADULT)

Doesn't live here . . . . . { (ATTEMPT TO GET PHONE NUMBER OR ADDRESS. IF UNSUCCESSFUL CODE 19 AND TRY DIRECTORY ASSISTANCE IF APPLICABLE.)

Deceased. . . . . (CODE 20)

Don't know person . . . . . (GO TO QUESTION 2)

Business number, person employed but not there. . . (ASK FOR A CALLBACK TIME)

Business number, person not employed. . . . . { (CODE 32 AND ASK IF THE RESPONDENT KNOWS HOW THE PERSON MIGHT BE CONTACTED)

Other . . . . . (SPECIFY _____)

2. Is this number (PHONE NUMBER)?

Yes. . . . . (CONFIRM THAT THE RESPONDENT DOES NOT KNOW THE SAMPLE PERSON AND END CALL)

No . . . . . { (ASK FOR CORRECT NUMBER AND RECORD HERE: (_____) _____ - _____. TERMINATE INTERVIEW AND REDIAL ASSIGNED NUMBER. IF SAME WRONG NUMBER IS REACHED, TERMINATE AND CODE 13.)

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D. QUESTIONNAIRE

INTRODUCTION: I have just six questions to ask. The purpose of the study is to develop data on pesticide usage and the number and size of businesses engaged in pesticide application. Your answers will assist us in identifying such businesses.

1. (Do you/Does [PERSON]) work either full-time or part-time as an applicator of pesticides?

   Yes. . . . . (CONTINUE)

   No . . . . . (THANK RESPONDENT AND END INTERVIEW)

2. (Do you/Does [PERSON]) work for a business that furnishes pest control services on a commercial basis, that is, for a fee?

   Yes. . . . . (CONTINUE)

   No . . . . . (THANK RESPONDENT AND END INTERVIEW)

3. (Are you/Is [PERSON]) self-employed, a partner, or an employee of such a pest control business?

   Self-employed. . . . .
   Partner. . . . . } (CONTINUE)
   Other. . . . . .

4. What is the complete name of the pest control business or businesses that you are now working for?

   a. _____

   b. _____

   c. _____

5. What is the complete address of (BUSINESS NAME)?

   a. _____

   b. _____

   c. _____

6. Which of the following types of applications does (BUSINESS) contract for?

	BUSINESS		
Lawn and Turf.	a	b	c
Tree, Shrub, and Ornamental.	a	b	c
Other (e.g., termites and other wood destroyers, commodity fumigations, etc.) . . .	a	b	c

Thank you for your cooperation and assistance in this research study. The businesses we have discussed may be selected to receive a questionnaire by mail in the near future. You can be assured that your name will not be mentioned when contacting the businesses. Again, thank you for your help.

STOP

APPENDIX C

Mail Screening Questionnaire

NATIONAL URBAN PESTICIDE APPLICATORS SURVEY
Mail Screening Questionnaire

CHECK THE BOX (☑) NEXT TO THE MOST APPROPRIATE ANSWER.

1. Do you work for a business that furnishes pest control services on a commercial basis, that is, for a fee?

☐ Yes ☐ No

2. Are you currently licensed in any state to apply pesticides?

☐ Yes ☐ No

IF THE ANSWER TO EITHER QUESTION 1 OR 2 IS "NO," THEN SIMPLY DETACH THE QUESTIONNAIRE AND MAIL IT. IF THE ANSWER TO BOTH QUESTIONS 1 AND 2 IS "YES THEN COMPLETE THE FOLLOWING.

ENTER BELOW THE COMPLETE BUSINESS NAME AND MAILING ADDRESS OF ALL COMMERCIAL PESTICIDE APPLICATOR BUSINESSES YOU CURRENTLY WORK FOR.

1. BUSINESS NAME _____

STREET/P.O. BOX _____

CITY _____ STATE _____ ZIP _____

TYPE OF APPLICATIONS CONTRACTED FOR:

☐ Lawn and Turf
☐ Tree, Shrub and Ornamental
☐ Termites and Other Wood Destroyers
☐ Commodity Fumigations
☐ General Pest Control
☐ Other (Specify) _____

EMPLOYMENT STATUS:

☐ Owner ☐ Partner ☐ Other

2. BUSINESS NAME _____

STREET/P.O. BOX _____

CITY _____ STATE _____ ZIP _____

TYPE OF APPLICATIONS CONTRACTED FOR:

☐ Lawn and Turf
☐ Tree, Shrub and Ornamental
☐ Termites and Other Wood Destroyers
☐ Commodity Fumigations
☐ General Pest Control
☐ Other (Specify) _____

EMPLOYMENT STATUS:

☐ Owner ☐ Partner ☐ Other

3. BUSINESS NAME _____

STREET/P.O. BOX _____

CITY _____ STATE _____ ZIP _____

TYPE OF APPLICATIONS CONTRACTED FOR:

☐ Lawn and Turf
☐ Tree, Shrub and Ornamental
☐ Termites and Other Wood Destroyers
☐ Commodity Fumigations
☐ General Pest Control
☐ Other (Specify) _____

EMPLOYMENT STATUS:

☐ Owner ☐ Partner ☐ Other

APPENDIX D

Memorandum For the Record:
NUPAS Nonresponse

RESEARCH TRIANGLE INSTITUTE
POST OFFICE BOX 12194
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27709
(919) 541-6000
SURVEY OPERATIONS CENTER

April 28, 1982

MEMORANDUM

TO: The Record

FROM: Dick Waddell

SUBJECT: Discussion of Response Problems and Alternative Methodologies in Support of NUPAS Project Meeting, 28 April 82, Washington, D.C.

Attached is a discussion of the response problems encountered at this time with the NUPAS mail survey. Also presented are various alternative methodologies that could be instituted in hopes of either gaining a better understanding of why firms are not responding or increasing the response to an acceptable level that will result in useful analyses for the Agency.

In support of this document is a memorandum concerning budget issues as well as several computer tabulations of the responses received to date. A review of these documents should be helpful in clarifying the problems encountered and arriving at a workable solution.

DW:db

Attachment

I. CURRENT STATUS OF NUPAS MAIL SURVEY

A. Update of Activities

The first mailing to sample organizations took place during the week of 29 March; the last batch was mailed from RTI on Friday, 2 April. Eight thousand ninety-three (8,093) cases were mailed in the first mailing; a secondary mailing to 627 firms was completed on Tuesday, 20 April. As of Monday, 26 April, 1,126 documents have been received at RTI (257 of these are returned undeliverables by the Post Office). At this point, the only central office activities underway are the receipt event keying and preparations for the second wave mailing.

B. Nonresponse Problems

Since the majority of questionnaires have been in the field for almost four weeks, the current response rate of 10.74% is somewhat disappointing and cause for concern. This is especially true considering the amount of publicity purportedly given the survey by the professional organizations. Based on information from these organizations and the anticipated enthusiasm in support of the survey, RTI projected a return from the first mailing to be approximately 40% or about 3,200 returned documents by this date. Obviously, we are well below this projection.

We are unable to determine exactly why the response has not been as good as expected but there are several situations that may have influenced a firm's decision on whether or not to participate. These include:

- Timing of the survey -- The first wave mailing was completed well into the start of the busiest season for most of the firms in the sample. Since business opportunities and commitments have a higher priority than completion of our questionnaire, the firms chose not to take the time to participate.

- Getting the questionnaire to any respondent -- Because of the volume of unwanted or junk mail probably received by sample firms, our

A complete frame of eligible firms in the category 3 states could not be constructed without first screening all applicators. Since this was not feasible under the time and cost constraints of the contract, a two-phase design was proposed and implemented. The first phase screened a sample of licensed applicators in each of the category 3 states. The purpose of this screening was to identify the employer (or employers) of the sample individuals and the employer's eligibility for NUPAS. The second phase of the design then selected a sample of the eligible firms identified in the first phase screening. This sample of firms was then treated like those firms selected from the category 1 and 2 states (i.e., a questionnaire was mailed to the sample firms for their completion and return. The intent of this report is to document the design/sample selection/screening activities in the seven category 3 states. Details of the actual data collection procedures and results are contained in the final report for NUPAS currently being prepared under separate funding.

Exhibit A.

Response Status for Telephone Screening in Seven Supplementary States

State	Census Division	Frame Members	Sample Members	Responding Eligibles	Responding Ineligibles	Refusals	Unable To Contact	No Listing	Response Rate
Arizona	37	1,160	344	68 (20%)	88 (26%)	7 (2%)	56 (16%)	125 (36%)	45%
Pennsylvania	12	1,685	500	134 (27%)	90 (18%)	11 (2%)	72 (14%)	193 (39%)	45%
Virginia	35	1,500	501	123 (25%)	150 (30%)	0 (0%)	73 (15%)	155 (31%)	54%
Nebraska	24	827	400	109 (27%)	177 (44%)	5 (1%)	78 (20%)	31 (8%)	72%
West Virginia	35	147	147	63 (43%)	12 (8%)	3 (2%)	23 (16%)	46 (31%)	51%
Massachusetts	11	1,234	500	172 (34%)	151 (30%)	14 (3%)	51 (10%)	112 (22%)	65%
Louisiana[1/]	37	349	166	23 (14%)	56 (34%)	8 (5%)	24 (14%)	55 (33%)	48%
Overall		6,902	2558	692 (27%)	724 (28%)	48 (2%)	377 (15%)	717 (28%)	55%

[1/] Does not include a supplemental list sample of 151 mostly structural firms.

II. MAIL SURVEY METHODOLOGIES

A. "Traditional" RTI Mail Survey Methodology

Although the methodology used in a mail survey will vary depending on many situations, a "traditional" RTI mail survey methodology has evolved since the Institute completed its first mail effort. Generally, this includes (1) the first mailing to the entire sample followed by (2) a thank you/reminder post card about one week after the mailing, again to the entire sample. Approximately two weeks after the first mailing, all nonrespondents would receive (3) a second questionnaire. About two weeks after the second mailing, the remaining nonrespondents would be telephoned and encouraged to complete the questionnaire and return it as soon as possible or complete the interview by phone. In some situations (at the request of the respondent) a third questionnaire could be mailed although this is not encouraged. The original NUPAS methodology called for a first wave mailing followed by a second mailing. Telephone prompting of nonrespondents and/or fail edit callbacks was an option to be exercised based on response rates and budget. The professional nature of the organizations involved and the support of the parent trade associations was instrumental in an earlier decision not to employ a thank you/reminder post card.

B. Alternative Methodologies

Clearly, the survey could continue using the proposed methodology; however, based on Institute experience and the returns thus far, it is doubtful that the final response rate would come near the proposed rate without some additional action. Therefore, it is RTI's feeling that alternative methodologies should be considered in an attempt to increase the response rate more

significantly than a simple second wave mailing would achieve. These options are discussed in the following sections.

- Use of Mailgrams -- Many mail surveys use mailgrams as a method of increasing response rates. The mailgram, transmitted electronically via Western Union, lends an air of importance to the survey, is quickly transmitted and received, and can be helpful in stimulating survey response. The per unit charge for a Mailgram containing up to 140 words is $1.50 plus $172 for set up of the computer tape for addressing. (Note: Although Mailgrams are helpful in increasing response, their effectiveness has been somewhat diminished since they have become so popular and frequently used.)

- Use of Computer Letter -- Another service offered by Western Union is the computer letter. This recent development allows organizations to transmit "form" letters with a "personal touch"; the letter is printed on yellow paper as is the envelope. Special notations add to its look of importance. The per unit cost of the computer letter is $.99.

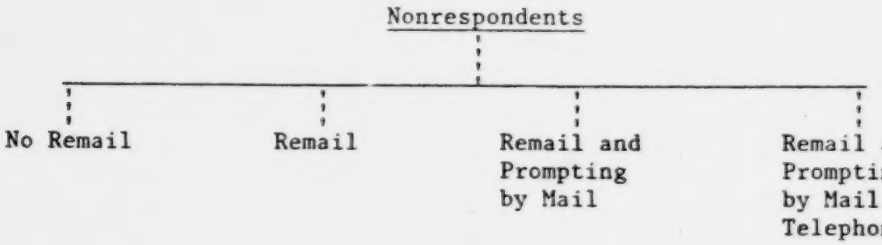
- Complete Second Mailing with Telephone Follow-Up -- The proposed methodology could be used which would allow for the second mailing to all nonresponding organizations with later telephone follow-up. The materials for this mailing have been prepared and are ready for mailing. The telephone follow-up of nonrespondents could begin within a week of the second mailing and serve as prompting for completion and mailing of the questionnaire or completion by telephone.

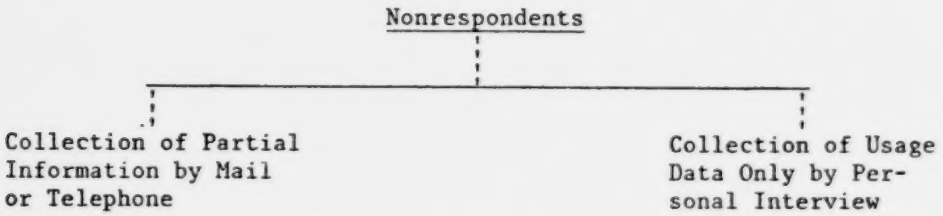
- Special Nonrespondent Substudy -- A nonrespondent substudy could be undertaken to identify the reasons for the poor response rate. A random sample of nonrespondents could be selected and telephoned to determine (1) whether or not the questionnaire had been received, (2) if it had been directed to the person most capable of answering the questions, (3) why the questionnaire has not been completed and returned, and (4) which questions, at a minimum, could be answered easily and with the least disruption to the firm's work activities.

- Telephone Prompting of all Nonrespondents -- Telephone interviewers could contact all nonrespondents before the second mailing to identify the most appropriate person to whom the questionnaire should be sent and secure a commitment to complete the questionnaire once received or make other arrangements (such as interview by phone).

- Additional Assistance from Professional Associations -- Additional assistance from the professional associations could be requested. Such assistance could include (after obtaining assurances that confidentiality requirements would not be violated) direct contact with nonresponding firms to seek their cooperation, "blanket" request for assistance through trade journals and other publications, or possibly some sort of additional support gained through contact with the states involved in the survey.

- Nonresponse Follow-Up Using Mixed Modes of Data Collection -- Mixed mode simply means that several different methodologies are used in handling either the total mail survey activities or only the nonrespondent cases. For the NUPAS, a hierarchy of prompting mechanisms could be used in hopes of increasing responses. These include dividing the nonresponse cases into groups with each group prompted via a different methodology as shown in the diagrams below.




Nonrespondents
Collection of Partial Information by Mail or Telephone
Collection of Usage Data Only by Personal Interview

- Use of Other Incentives -- Other incentives could be used to increase the response. These include:

  (1) Payment of cash (possibly even a token amount such as 50¢ although more could be paid) can be useful in increasing response,

  (2) Offering firms a computer-generated profile of their industry at the completion of the study,

  (3) Offer of non-cash incentive such as an inexpensive office item or other incentive.

- Conduct of a Pilot Study -- Similar to the special nonrespondent substudy, a pilot study could be developed in an attempt to identify response problems and mechanisms to increase the response rate. This would involve selecting a sample of nonrespondents (or possibly contacting all cases) to obtain additional information or complete the questionnaire. For the most part, the thrust of the pilot study would be methodology that would benefit future efforts to collect such data.

III. RECOMMENDATIONS AND FURTHER CONSIDERATIONS

A. Ramifications of Delays in Action

Attention should be brought to the fact that the NUPAS questionnaire asks for information related to sales and usage from the latest fiscal year. The longer the elapsed time from the latest fiscal year, the less likely the data will be reported for the desired time period. The differences in the reporting period across the sample will complicate analysis and detract from the total sales and usage data reliability. Therefore, a decision on how to handle the nonresponse situation should be made as soon as possible.

B. Problems with the Computer Control System (FORCE) Using Mixed Mode Data Collection Follow-Up

The FORCE system, a simple data receipt computer monitoring system, is being used for the NUPAS. Because the system is designed to efficiently handle the most basic survey operations (as opposed to several more expensive and more sophisticated systems used on larger surveys), there is the possibility that FORCE would either require modifications or perhaps not be capable of monitoring follow-up activities using mixed mode methodologies. Such changes to FORCE, and certainly "bringing up" another control system to handle mixed mode operations, would be costly and require some time. This should be considered if mixed mode operations are employed.

C. Budgetary Considerations

As stated in Dr. Drummond's supporting memorandum concerning budget issues, all nonresponse follow-up activities are accompanied by costs. When considering the methodology that will result in the highest response, the cost implications of that methodology should be reviewed. A significant amount of

money has been spent to date and how best to use the remaining funds should be of highest priority.

D. Usefulness of Data

Finally, before a decision is made on how to proceed on the NUPAS, RTI suggests that consideration be given to the usefulness of the data that could result using the proposed methodology. It would perhaps be more appropriate to be able to report the most complete and more reliable data on a smaller sample base than strive for mere numbers (responses) that would ultimately produce data that are not as reliable and complete.